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OF THE
Indian Cotton
Committee



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REPORT
OF THE
Indian Cotton
Committee



1919

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CHAPTER I.

Introductory.

1. The Committee was appointed by the Governor General in Council under the Resolution of the Revenue and Agriculture Department No. 933-263, dated September 27th, 1917, the first two paragraphs of which are reproduced below.

**Appointment of Committee
and terms of reference.**

“ The question of extending the cultivation of long stapled cotton in India is one which has frequently engaged the attention of the Government of India. It has again been brought into special prominence as the result of recent investigations by the Board of Trade which have shown the importance in Imperial interests of increasing the production of this class of cotton within the Empire. The Government of India consider it desirable that India should co-operate in the solution of this problem and they believe that the interests of this country in the matter will be found to coincide with those of Lancashire. It has repeatedly been urged by manufacturers in India that it is of even greater importance to them than to manufacturers elsewhere that sufficient cotton of long staple should be forthcoming in this country and that the extension of the growth of improved cotton would react most favourably on the manufacturing industry. There are certain areas in which there is reason to believe that long staple cotton will give a sufficiently large yield to enable it to be grown at a profit. Here the problem is one mainly of organization. In other areas, which include the majority of the cotton growing tracts in India, a type of cotton combining yield and quality in sufficient degree to enable it to compete successfully with the prevailing short staple types does not appear to have been as yet evolved and the question of research will enter largely into the solution of the problem. An extension of the growth of long staple cotton in the above two cases would, in all probability prove of great benefit to the cultivators owing to the higher prices which long staple cotton commands, provided that the full benefit of these prices can be secured to them by improvements in the system of marketing and by the prevention of the harmful practices of adulteration and damping which have done so much in the past to lower the reputation of Indian cotton. In these circumstances, the Government

of India have decided that the possibilities of extending the growth of long stapled cotton in India should be investigated by a Committee constituted as follows :—

J. MacKenna, Esq., C.I.E., I.C.S., Agricultural Adviser to the Government of India	President.
F. Hodgkinson, Esq., Member, of the Council of the British Cotton Growing Association	Members.
N. N. Wadia, Esq., Member of the Committee and Ex-Chairman, Bombay Millowners' Association	
G. S. Henderson, Esq., Officiating Imperial Agriculturist	
W. Roberts, Esq., Principal and Professor of Agriculture, Lyallpur Agricultural College	
H. F. Ashton, Esq., Executive Engineer, Punjab	
F. Noyce, Esq., I.C.S.	Secretary

2. The Committee will examine the work which has been done in the various provinces of India in the establishment of long stapled cottons. It will report regarding the possibility of the extension of any methods which have led to success. It will investigate the causes of failure where this has occurred, and, if it finds that the failure has been due to agricultural, irrigational or economic causes or to administrative difficulties, will propose appropriate remedies. It will carry out a detailed study of local conditions in each cotton growing tract and will enquire into the possibility of improving existing methods of ginning and marketing and also of preventing adulteration and damping. It will further report on the possibility of improving the accuracy of the cotton forecasts and generally of making the statistical information published by Government of greater utility to the cotton trade. Finally, it will submit recommendations in regard to the staff required and the organization necessary for the development of the cultivation of long stapled cottons in tracts which it considers suitable for that purpose.

2. With the exception of Mr. Hodgkinson who joined us at Cawnpore on October 31st, we assembled at Lyallpur

Procedure adopted.

on October 8th, 1917 and thereafter toured in the Punjab, Sind, the United Provinces, the Central Provinces and Central India (Bhopal, Gwalior and Indore) until the end of November. A break in December was necessary mainly owing to the meeting of the Board of Agriculture held that month at Poona. We reassembled at Lahore on January 6th, 1918, and then toured in the Punjab, Sind, Bombay, Baroda, Hyderabad and Madras. Mr. Henderson ceased to be a member of the Committee on February 4th, his services being required in Mesopotamia. We have, however, had opportunities of consulting him whilst our Report was being drafted and, as he finds himself in agreement with the conclusions at which we have arrived, he has signed the Report. As we were desirous of seeing the cotton crop on the ground over as large an area as possible, time did not permit of our taking formal evidence in the Punjab and Sind during the first part of

our tour and a second visit to these provinces had, therefore, to be made. Time again did not permit of our touring in those provinces in which cotton is a crop of minor importance. The evidence of witnesses from Burma and the North-West Frontier Province was, however, taken at Poona during the meeting of the Board of Agriculture, at which all the members of the Committee, with the exception of Mr. Ashton, were present. That of witnesses from the North-West Frontier Province was taken at Lahore and of witnesses from Burma, Bengal and Bihar and Orissa at Calcutta. A copy of our itinerary is appended (Appendix I). During our tour, in the course of which we travelled 15,540 miles by rail and steamer and 586 miles by road, we held 67 sittings and examined representatives of eight Chambers of Commerce and other bodies connected with the cotton trade and 263 individual witnesses, almost all of whom had previously sent in written memoranda. Of the individual witnesses, 114 were officials, mainly from the Agricultural and Public Works (Irrigation) Departments and 149 non-officials. 115 witnesses were Europeans, 147 Indians and one Japanese. We also received written memoranda from 32 individuals interested in our enquiry, who were not orally examined. In addition to visiting almost all the Government farms in the provinces in which cotton is grown, we inspected a very large number of ginning and pressing factories and of spinning and weaving mills and also held many informal meetings with cultivators, ginners, brokers, representatives of co-operative societies and other persons connected with cotton. We wish to take this opportunity of acknowledging the great assistance rendered to us throughout our enquiries in all provinces and Native States, especially by Directors of Agriculture, the Director of Statistics and the representatives of the Bombay cotton trade and to express our appreciation of the care and trouble taken in the preparation of the evidence submitted to us. We have also to thank Mr. G. A. Gammie, the Imperial Cotton Specialist, for valuable assistance in drafting our Report.

3. A brief reference to the conditions which brought about the appointment of our Committee appears called for. As Mr. J. A. Hutton, late Chairman of the British Cotton Growing Association, Professor J. A. Todd, now Secretary of the Empire Cotton Growing Committee, and Mr. A. S. Pearse, Secretary of the International Federation of Master Cotton Spinners and Manufacturers' Associations have emphasized on many occasions, the basic fact of the situation in regard to cotton is that there has been a distinct tendency for the world's demand for the raw material to exceed the supply and that consumption has, in fact, only been limited by the quantity of cotton available. As the figures we have reproduced in Appendix II show, the total world's production, in pre-war conditions, is estimated by Professor Todd at about 25½ million bales, of which the United States produced 15 million bales. The American crop forming, as it does, very nearly three-fifths of the total outturn of cotton is, therefore, the predominating factor in the world's markets. During the first three years after the war broke out, it averaged only 13½ million bales whilst the crop of

1917-18 was estimated at only 12 million bales and that for 1918-19 is estimated at 12½ million bales. Table 4 in Appendix II shows the very striking increase in the proportion of the crop consumed by American mills. Whereas in the quinquennium 1890-95, it averaged only 2,758,000 bales out of a crop of 8,346,000 bales or 33·05 per cent., in the quinquennium 1910-15, it averaged 5,769,000 bales out of a crop of 14,558,000 bales or 39·63 per cent. For the three years 1915-18, it averaged 7,600,000 bales out of a crop of 12,871,000 bales or 59·14 per cent. It is evident, therefore, that unless fresh sources of supply are rapidly developed, the high prices of cotton at present prevalent are not likely to fall to any appreciable extent, even with a return to more normal conditions, especially as all the countries of the world will be seriously short of cotton after the war.

In these circumstances, it is obvious that the Lancashire cotton industry, the importance of which to the Empire needs no comment from us, is faced with a serious situation and that it is most desirable that it should cease to be almost entirely dependent on a source of supply, the future of which is so problematical. It is equally desirable, in the interest of the Empire as a whole that an alternative source of supply should be found within the Empire. India, as the largest cotton producing country in the Empire and the second largest in the world, clearly offers the greatest possibilities of any considerable increase in the supply of cotton in the near future. Apart altogether from the possibilities of an extension of the area under cotton as the result of high prices or of the provision of irrigation facilities and of obtaining an increase in outturn by the introduction of superior varieties, the average yield per acre of the Indian crop is only about 85 pounds of lint whilst that of the United States crop is nearly 200 pounds per acre and of the Egyptian crop 450 pounds. The condition of affairs is, moreover, even worse than is represented by these figures owing to the condition in which Indian cotton is marketed. It has been estimated that Indian cotton loses about ten per cent. more in the blow-room than American or Egyptian, thus reducing the real average yield per acre to about 76 pounds. The scope for obtaining an increase in outturn merely by an improvement in agricultural practice is therefore considerable.

Of the average annual Indian crop of between four and five million bales, very little is, at present, used by Lancashire, as is shown by the fact that the average exports to the United Kingdom for the five years ending 1917-18 were 215,000 bales only, of which a large amount, in regard to which we have not been able to obtain exact figures, was re-exported. As far as Lancashire is concerned, the immediate necessity is an extension of the cultivation of long staple cotton in India. The problem is no new one. It has occupied the attention of the Government of India since 1788. But whereas the efforts to extend the cultivation of cotton, more especially of exotic varieties, during the early part of the last century had for their object to render Lancashire independent of the American supply, the position now is that India herself has a

flourishing cotton industry, which is interested, equally with Lancashire, in the question of obtaining larger supplies of better cotton. The tendency already visible before the war in this country in the direction of spinning higher counts up to 30s twist has, we understand, become much more marked during the last two years and there is every reason to believe that the advance in this respect will be maintained when the war is over. All the evidence submitted to us by the representatives of the manufacturing interests in India emphasized the importance which the Indian cotton industry attaches to the development of long staple cotton in this country.

4. It is perhaps desirable that we should at the outset, state our views as to the possibility of growing in India cotton of sufficient long staple to meet the requirements of Lancashire and to replace American cotton in the Lancashire mills.

Possibility of Indian cotton replacing American for Lancashire purposes.

It is a matter of common knowledge that the cotton trade practically originated in England and that, at one time, the export trade in manufactured goods was almost entirely in the hands of Lancashire. Owing to the development of cotton manufacture in other countries, the Lancashire spinners have been compelled to confine themselves, in an increasing degree, to finer counts for which longer and finer qualities of cotton are required. The results of our enquiries as to the cottons grown in India which are suitable for the purposes of Lancashire are shown in the table appended to this chapter. We are of opinion that the only parts of India from which assistance of real value to Lancashire can be expected in the near future, except in the important matter of hosiery yarns to which reference is made in the next paragraph, are the tracts in which cotton of an inch or slightly more in staple can be grown in large quantities. It will be seen from the table appended to this chapter and from the subsequent chapters of our Report that the only tracts which answer to this description at present are those parts of Madras in which Cambodia and *karunganni* cotton are grown and the Punjab, where American cotton is making rapid headway. If the new varieties at present under trial in the latter province can be successfully established, it will fulfil the necessary conditions to a greater extent than it does now. Egyptian and American cotton has been successfully grown in Sind, in spite of difficulties, and we consider that cotton of both these types of a quality better than any grown in the Punjab and up to $1\frac{1}{4}$ inch in staple could be grown in that province with ease, provided that perennial irrigation were ensured by the construction of the Sukkur Barrage, a point with which we have dealt in detail in Chapter VI. Our conclusion is, therefore, that India cannot, for at least ten years, grow cotton in any large commercial quantity of a staple longer than $1\frac{1}{8}$ th inch. Up to this length, we think Madras might furnish 500,000 bales and the Punjab 200,000 bales, but these cottons will only be capable of spinning up to 34s twist and 44s weft in the Lancashire mills, if the conditions in those mills continue as at present. We think, however, that there will be a demand from Lancashire for cotton for spinning counts up to these degrees of fineness for a very long time to

come. We would add that every extra bale of long staple cotton, as the term is understood in this country, will liberate a corresponding bale of other growths for Lancashire and that therefore the proposals we have made with a view to securing an increase in the Indian crop will tend equally to the advantage of the Lancashire and Indian industries.

5. Whilst the supplies of long staple cotton for which Lancashire can look to India are limited by the considerations set forth above, there is one important branch of the Lancashire trade, that in hosiery yarns, in which India is in a position to render Lancashire very material assistance and it is somewhat surprising that some of the indigenous Indian cottons have not been utilized more largely for this purpose. The "Northern" and *karunganni* cottons of Madras, the Broach and *kumbla* cottons of Bombay and the *gaorani* cotton of Hyderabad are of excellent colour and strong and regular in staple, the length of which is from $\frac{5}{8}$ th inch to one inch. If cotton of these varieties were picked in a clean condition, carefully ginned and pressed and shipped in a pure state, it would spin an excellent, full and even yarn suitable for the hosiery trade, especially if certain necessary alterations were made in the preparation machinery in Lancashire. At present, the exports of this class of cotton go almost entirely to Japan and the Continent, the hosiery from which is being increasingly used in India as under-clothing by the better classes. We consider it very desirable that Lancashire should realize that there are large classes of cotton grown in India which could be extensively utilized for this purpose.

6. We would mention that, though our enquiries have been primarily directed to the possibilities of extending the cultivation of long staple cotton in India, it has been impossible to confine them to this aspect. The problem of securing to the cultivator the proper price for his cotton, with which that of preventing the practices of damping, mixing and adulteration is closely connected, affects both long and short staple cotton. We have had also to consider the desirability of preventing the incursion of short staple cotton into areas which grow long staple cotton. We have had, in short, to examine the cotton question in India as a whole and to frame our recommendations accordingly. To avoid all possibility of misconception, we would wish here to emphasize that our primary consideration throughout has been the interests of the Indian cultivator. We have not recommended nor, we are glad to say, did any of the witnesses before us suggest that any steps should be taken to make him grow any variety of cotton except that which pays him best in the local conditions.

7. It seems desirable, at this stage, to define some of the terms we have used in our report. We have found it convenient to use the term *deshi* cotton for all varieties of cotton indigenous to India as opposed to exotics, such as the various Egyptian and American varieties. The vernacular word

kapas is so well understood throughout India to mean unginned cotton, i.e., cotton before the seeds have been removed, as opposed to lint or cleaned cotton, that we have had no hesitation in using it in that sense. We have found some difficulty in deciding on an exact definition of the terms "long staple" and "short staple." We understand that, in Bombay, any cotton with an actual measurement of three quarters of an inch or over is regarded as long staple. For the purposes of the Lancashire mills, what is known as a "commercial inch" is regarded as long staple, the actual measurement, however, being something less, say rather over seven-eighths of an inch. We have appended to this chapter a complete list of the different varieties of cotton grown in India, under their trade classification, showing the tracts in which they are at present grown together with an approximate estimate of their area and outturn in a normal season. The season is, however, seldom, if ever, normal over the whole of India and, for this reason the total figure of outturn in the table is somewhat above the average for the quinquennium 1913-18, which was almost exactly 4,500,000 bales. The average area for the same period was 22,777,400 acres. The latest estimate of the area and outturn for 1918-19 are 19,677,000 acres and 3,282,000 bales. We would suggest that the Provincial Departments of Agriculture should keep that part of the annexure relating to the local varieties up to date, taking special care to render the statements of acreage and outturn more exact as time goes on. The varieties which come under the Bombay definition of long staple cotton are shown in bold type in the table, those falling under the Lancashire definition being also underlined. We would explain that both in this table and elsewhere in our Report, we have adopted Mr. Gammie's classification of Indian cottons, which is the one generally followed by the Agricultural Department in India. We would mention, however, that it is not accepted by all botanists, some of whom consider that many of the species and varieties enumerated by Mr. Gammie are not, in reality, separate.

8. We have divided our report into two parts, the first of which deals with the agricultural and irrigational **Scheme of the Report.** and the second with the commercial aspect of the questions which have come under our consideration. As the problems in regard to the cultivation of cotton and the possibilities of its extension differ so widely in different parts of India, we have thought it advisable to deal with these for each Province separately and have done so in Chapters II-XIV below. In Chapter XV, we have discussed various agricultural questions of general application to all provinces. These chapters constitute Part I of the Report. In Chapter XVI, we have dealt with general trade questions and, in Chapter XVII, with questions of statistics. In Chapter XVIII, we propose the establishment of a Central Cotton Trade Association in Bombay and, in Chapter XIX, the formation of a Central Cotton Committee to co-ordinate all work on cotton throughout India and have dealt in detail with the functions which we consider should be assigned to these two bodies. These chapters constitute Part II of the Report. As the recommendations in Part

I affect primarily the work of the Agricultural and Irrigation Departments whilst those in Part II are of more special interest to the trade, we have endeavoured to make each part of the Report as complete as possible. Some small amount of repetition has, therefore, been unavoidable.

9. We cannot adequately express our appreciation of the services rendered to the Committee by our Secretary,

Services of Secretary. Mr. Frank Noyce, I.C.S. The preliminary examination and abstraction of literature on the subject was done by him with a completeness which considerably lightened our labours. All the details of our tours and enquiries were worked out with a thoroughness which is above praise. It would, in fact, have been impossible to have finished our task in the time at our disposal, had it not been for the excellent arrangements made by our Secretary. Mr. Noyce has spared himself in nothing and at every stage of our labours and not the least in the final drafting of our Report, we have felt ourselves under a debt of obligation to him to which we now desire to give expression.

ANNEXURE I.

ANNEXURE

Trade classification.		Botanical variety.	Length of staple in eighths of an inch and in millimetres.	Ginning percentage.
Oomras.	1. Bani* (Hinganghat Barsi or gaorani).	<i>G. indicum</i> (Lamk)	1 in. to 1-1/8 in. or 25 to 27 mm.	25
	2. Buri . . .	<i>G. hirsutum</i> (Mill)	7/8 in. to 1 in. . .	31
	3. Malwa* . . .	<i>G. neglectum malvense</i> (Gammie).	6/8 in. to 7/8 in. or 18 to 20 mm.	25
	4. Central India . . .	Berar mixture, vide 5 below. 1	5/8 in. to 6/8 in. . .	33
	5. Berar and Central Provinces.	Mixture of varieties of <i>Gossypium neglectum</i> , viz.:— <i>G. N. malvense</i> . . . <i>G. N. verum</i> . . . <i>G. N. roseum</i> . . . <i>G. N. cutchicum</i> . . . and of <i>G. indicum</i> and <i>G. hirsutum</i> . . .	6/8 in. to 7/8 in. } 5/8 in. to 6/8 in. } 4/8 in. to 5/8 in. } 5/8 in. to 4/8 in. to 5/8 in. } 6/8 in. 1 in. to 1-1/8 in. } 6/8 in. to 7/8 in. }	25 } 30 } 40 } 38 } 25 } 31 }
Oomras.	6. Roseum . . .	<i>G. N. roseum</i> . . .	4/8 in. to 5/8 in. or 15 mm. as a maximum . . .	40
	7. Khandesh . . .	A mixture of varieties as in Berar cotton with the exception of <i>G. indicum</i> .	Slightly less in each variety than in Berar cotton. Average 4/8 in. to 5/8 in.	32
	8. Khandesh roseum . . .	<i>G. N. roseum</i> . . .	3/8 in. to 4/8 in. or 11 mm.	38
Dholleras.	9. Wagad . . .	<i>G. herbaceum Sakalia</i> . . .	6/8 in. to 7/8 in. or 18 to 20 mm.	33
	10. Latio . . .	<i>G. herbaceum</i> . . .	5/8 in. to 6/8 in. or 16 mm.	33
	11. Goghari . . .	<i>G. herbaceum</i> . . .	4/8 in. to 5/8 in. or 14 mm.	40
	12. Rozi or Jaria . . .	<i>G. obtusifolium</i> . . .	4/8 in. to 5/8 in. or 13 mm.	35
	13. Mathio . . .	Khandesh mixture and <i>G. neglectum kathiawarensis</i> .	As of Khandesh mixture . . .	32

* See note to

I.

Tract where grown.	Estimated area in acres.	Estimated outturn in bales.	REMARKS.
Hinganghat district of the Central Provinces and the northern part of the Nizam's Dominions. It is also grown as a cold weather crop in the Chanda District of the Central Provinces.	840,000 (Grown with Khandesh cotton on 530,000 acres in Hyderabad a d. See 7 below.)	168,000	830,000 acres of this is returned from Hyderabad where it is known as <i>gaorani</i> . Largely mixed with Berar cotton in most tracts in which the latter is grown.
Grown in North-East Hyderabad and to a small extent in Chota Nagpur, the United Provinces and the Central Provinces.	2,000	500	There were 6,000 to 7,000 acres under this variety in the Central Provinces some years ago. 115,000 acres are returned from Hyderabad but this is probably Berar cotton with a large mixture of Upland American and has been included in No. 7 below.
Malwa Plateau in Central India	112,000	22,000	Often mixed with lower grade <i>neglectum</i> varieties; when pure the staple is 20 mm.
Central India States . .	1,400,000	300,000	<i>Roseum</i> from the Central Provinces is gradually spreading in this tract.
Berar and Western part of Central Provinces (excluding the area under <i>roseum</i>).	3,700,000	571,000	Cotton classed as "Fine Berars" contains a higher proportion of <i>G. hirsutum</i> , <i>G. N. malvense</i> and <i>G. indicum</i> (<i>bani</i>) than the remainder. The average ginning percentage is 33 in the north of the provinces where <i>G. N. malvense</i> and <i>verum</i> form a high proportion of the mixture.
TOTAL .	6,054,000	1,061,500	
Berar and adjoining tracts .	700,000	180,000	The area given is that in which <i>roseum</i> is grown pure.
East and West Khandesh, Ahmednagar, Sholapur, Nasik, North Bijapur and adjoining tracts of Hyderabad.	3,620,000	560,000	530,000 acres is returned from Hyderabad as mixed with <i>bani</i> (<i>gaorani</i>) and 115,000 acres as mixed with <i>buri</i> (vide Nos. 1 and 2 above).
Ditto . .	30,000	6,000	Replacing the Khandesh mixture as <i>roseum</i> in Berar is replacing the Berar mixture.
North Gujarat (chief centre Viramgam), Kathiawar and Cutch.			The bolls do not open. The cotton is picked in the bolls and beaten out afterwards.
Light soils in north Gujarat .			
To the north of the Broach tract in a pure state. About 50 per cent. of the crop is grown in Broach district.	2,100,000	585,000	When mixed with Broach is a constituent of <i>kanvi</i> (vide No. 25).
Kaira and north of Baroda .			
Kathiawar and Ahmedabad }			It is impossible to give the outturns and areas of the varieties which make up Dholleras separately.

Trade classification.		Botanical variety.	Length of staple in eighths of an inch and in millimetres.	Ginning percentage.
Bengals.	14. United Provinces .	A mixture of the following varieties :— <i>G. indicum</i> <i>G. indicum Mollisoni</i> (Gammie). <i>G. N. malvense</i> (Gammie). <i>G. N. verum</i> <i>G. N. bengalense</i> (Gammie). <i>G. N. roseum</i> <i>G. N. cutchicum</i>	6/8 in. or 18 mm. . . . 4/8 in. or 12 mm. . . . 5/8 in. or 15 mm. . . . 4/8 in. to 5/8 in. or 13 mm. 5/8 in. to 6/8 in. or 15-18 mm. 3/8 in. or 11 mm. . . . 3/8 in. or 11 mm. . . .	32 40 30 36 33 38 36
	15. White flowered Allgarh.	<i>G. N. roseum</i>	3/8 in. or 10 mm. . . .	39
	16. Rajputana . . .	As in No. 14 above . . .	As in No. 14 above . . .	33
	17. South East Punjab.	Ditto	Ditto	33
	18. Sind	As in No. 14 but excluding <i>G. N. bengalense</i> and including <i>G. obtusifolium</i> .	3/8 in. to 5/8 in. or 10-14 mm.	35
Sind, Punjab.	19. Punjab	As in No. 14 but excluding <i>G. N. bengalense</i> and <i>cutchicum</i> and including <i>G. obtusifolium</i> and <i>G. sanguineum</i>	4/8 in. 5/8 in. to 6/8 in. or 15-18 mm. 5/8 in. or 15 mm. . . .	33 33 32
	20. North-West Frontier Province. 19	As in No. 19 with the exception of <i>G. sanguineum</i> .	5/8 in. to 6/8 in. or 15-17 mm.	32
Others.	21. Bihar and Orissa .	As in No. 14 but with a smaller proportion of <i>G. indicum</i>	3/8 in. to 4/8 in. . . .	34
Broach.	22. <u>Nasari</u>	<i>G. herbaceum</i> (Linn)	7/8 in. to 1 in. or 23 mm. . .	31
	23. <u>Surat</u>	Ditto	7/8 in. or 21 mm. . . .	32
	24. Broach	Ditto	5/8 in. to 6/8 in. or 15 mm.	32
	25. Broach Goghari and Kanvi.	Ditto	4/8 in. to 6/8 in. or 15 mm.	35
Kumbla Dharwar.	26. Kumbla Dharwar* .	<i>G. herbaceum</i>	7/8 in. or 21 mm. . . .	26
	27. Saw Ginned Dharwar	A mixture of Upland (<i>G. hirsutum</i>) and New Orleans (<i>G. mexicanum</i>) types, the former predominating.	6/8 in. to 7/8 in. or 18-21 mm.	30
Westerns and Northern.	28. Westerns	<i>G. herbaceum</i> with traces of <i>G. indicum</i> .	6/8 in. or 17-20 mm. . . .	25
	29. Northern *	A mixture of <i>G. herbaceum</i> and <i>G. indicum</i> .	7/8 in. or 21 mm. . . .	27

* See note to

I—contd.

Tract where grown.	Estimated area in acres.	Estimated outturn in bales.	REMARKS.
United Provinces	1,120,000	290,000	Fine Bengals contain a high proportion of <i>G. N. malvense</i> and <i>verum</i> .
Aligarh and surrounding tracts	120,000	24,000	Selected by the Agricultural Department.
Rajputana	372,000	120,000	
South-East Punjab, i.e., South of a line from Hissar to Ambala.	309,000	100,000	
Sind	245,000	67,000	Very white in colour.
Punjab, North-West of line from Ambala to Hissar.	1,400,000	330,000	Average staple west of Lahore 5/8 in.; east of Lahore 3/8 in. to 4/8 in.; <i>G. sanguineum</i> found only in south-west.
Peshawar Valley	38,000	10,000	Generally superior to Punjab cotton.
Mainly in the Saran, Santhal Parganas and Ranchi Districts of Bihar and Orissa.	74,000	17,000	....
TOTAL .	16,182,000	3,350,500	
Bilimora, Navsari	1,210,000	280,000	It is impossible to give the outturns and areas of these varieties separately.
Surat and Southern part of Broach District.			
Northern parts of Broach District from Hansot to Amod.			<i>Kanvi</i> is a mixture of Broach and <i>goghari</i> . The latter is spreading in the Broach tract.
Part of the Amod and the whole of the Jambusar talukas grow <i>goghari</i> .			
From Satara District southwards down to and including the Northern Districts of Mysore.	1,200,000	240,000	Staple shorter in eastern tract, viz., about 6/8 in. Very leafy cotton.
Southern part of Dharwar District and Northern Districts of Mysore.	250,000	55,000	Frequently grown mixed with <i>kumpla</i> .
Anantapur and Bellary Districts of Madras, part of Bijapur District of Bombay and south-west Hyderabad.	650,000	85,000	Madras.
	500,000	65,000	Hyderabad and Bombay.
			A very leafy cotton.
Kurnool and part of Cuddapah Districts (chief centre Nandyal).	439,000	65,000	Red and white. A very leafy cotton. The ginning percentage has been raised from 25 to 27 by selection.

ANNEXURE

Trade classification.		Botanical variety.	Length of staple in eighths of an inch and in millimetres.	Ginning percentage.
Tinnevellys.	30. <u>Coconadas</u> * . .	<i>G. obtusifolium coconada</i> (Gammie) and <i>G. indicum</i> (yerrapatti).	5/8 in. to 7/8 in. or 15-21 mm.	23
	31. <u>Karunganni</u> . .	<i>G. indicum</i> (karunganni)	7/8 in. or 22 mm. . .	32
	32. <u>Tinnevellys</u> . .	<i>G. herbaceum</i> and <i>G. indicum</i> (karunganni).	6/8 in. to 7/8 in. or 20 mm.	27
Salem.	33. <u>Uppam</u> . .	<i>G. herbaceum</i> . .	6/8 in. or 18-20 mm. . .	25
	34. <u>Nadam</u> . .	<i>G. obtusifolium</i> . .	6/8 in. to 7/8 in. or 18 to 21 mm.	23
	35. <u>Bourbon</u> . .	<i>G. purpurascens</i> . .	1 in. or 25 mm. . .	25
	36. <u>Cambodia</u> † . .	<i>G. hirsutum</i> (Mill) (from Cochin China).	Unirrigated 5/8 in. to 7/8 in. or 15-21 mm. Irrigated 6/8 in. to 1-1/8 ins.	33
	37. <u>Punjab American</u> .	<i>G. hirsutum</i> (Mill) . .	7/8 in. or 21-22 mm. . .	32 to 33
	38. <u>Cawnpore American</u>	<i>G. hirsutum</i> (Mill) . .	7/8 in. to 1 in. . . .	31
	39. Comillas . .	<i>G. cernuum</i> and <i>G. sylhetense</i> .	3/8 in. to 4/8 in. or 9 to 10 mm.	43
Burmas.	40. Wa-gale . .	A mixture of <i>G. neglectum verum</i> and <i>G. neglectum roseum</i> .	4/8 in. to 6/8 in. . .	30
	41. <u>Wa-gyi</u> * . .	<i>G. obtusifolium</i> (Nanking)	6/8 in.	39 to 40
	42. Shan Hills . .	Not yet classified . .	1 in.	25
	43. Jathla . .	<i>G. intermedium</i> . .	5/8 in. to 6/8 in. or 15 to 17 mm.	17
	44. Baluchistan . .	<i>G. obtusifolium hirsutum</i>	6/8 in. or 18 mm. . .	28

* See note to Annexure II.

† See Annexure II.

N.B.—In drawing up this list, an attempt has been made to give as accurate a measurement of the staple of Punjab American which is given above as 7/8ths inch is considered by Mr. A. S. Pearce to be

—concl'd.

Tract where grown.	Estimated area	Estimated outturn in bales.	REMARKS.
Guntur and parts of the Nellore, Kistna and Godavari Districts of Madras and south-east Hyderabad.	261,000	40,000	Very variable in staple; probably contains many types.
Tinnevely, Madura and Ramnad.	220,000	50,000	A distinct agricultural race of <i>G. indicum</i> selected by the Agricultural Department.
Madura and Ramnad . . .	320,000	84,000	Being replaced by pure <i>karunganni</i> .
Coimbatore, Trichinopoly and parts of South Arcot.	154,000	25,000	All these varieties are grown comparatively pure. <i>Nadam</i> and Bourbon are perennial cottons. <i>Uppam</i> is being replaced by Cambodia and <i>karunganni</i> .
	20,000	2,000	
	10,000	2,000	
Coimbatore, Trichinopoly and Madura Districts of Madras on red soils.	188,000 (Irrigated).	200,000	A considerable proportion of the unirrigated crop is on the ground for two or three years.
Small areas in Dharwar District of Bombay, the Chhattisgarh division of the Central Provinces and Hyderabad.	283,000 (unirrigated).		
Punjab Canal Colonies in districts of Lyallpur, Montgomery, Jhang, Shahpur, Gujranwala and Multan.	276,000	100,000	Staple varies from 6/8 in. to 1 in. Area in 1918 estimated at 350,000 acres. All irrigated.
Cawnpore	2,000	500	All irrigated.
Eastern Bengal and Assam	98,000	30,000	Very rough cotton. <i>G. sylhetense</i> is <i>khaki</i> coloured.
Mainly in dry zone of Burma	246,000	54,000	A small mixture of <i>G. neglectum</i> <i>verum kokatia</i> known as <i>wa-gale</i> occurs in <i>wa-gale</i> .
Prome and Thayetmyo			It is impossible to give the areas and outturns of these varieties separately but <i>wa-gale</i> probably forms at least seven-eighths of the crop.
Shan Hills			
Bihar and Orissa			
Baluchistan	Do.	..	Area and outturn insignificant.
TOTAL	22,499,000	4,728,000	

lint as possible. The trade often adds an extra 1/8th inch to the measurements given above: thus 7/8ths inch to 1-1/8th inch.

ANNEXURE II.

In the following table, the cottons which may be considered to come under the definition of long staple from the point of view of Lancashire and Bombay respectively (*vide* paragraph 7 above) and the commercial quantities of each which may be considered available in present conditions are shown in Class I and Class II.

Trade name of cotton.	Area.	Estimated quantity falling in specified class.
<i>Class I (Lancashire).</i>		
Tinnevellies (karunganni)	220,000	50,000
Bourbon	10,000	2,000
Cambodia (irrigated)	188,000	100,000
Punjab American	276,000	100,000
Cawnpore American	2,000	500
Buri	2,000	500
Broach Navsari	Separate figures not available.	
Broach Surat	Ditto.	
*Bani	840,000	168,000
*Northerns	439,000	65,000
*Kumptas	1,200,000	240,000
TOTAL	3,177,000	726,000
<i>Class II (Bombay).</i>		
Cambodia (unirrigated)	283,000	100,000
Tinnevellies	320,000	84,000
Westerns	1,150,000	150,000
Saw ginned Dharwar	250,000	55,000
Wagad	Separate figures not available.	
Salems { Uppam	154,000	25,000
{ Nadam	10,000	2,000
† Malwa	112,000	22,000
† Coconadas	261,000	40,000
† Wa-gyi	Separate figures not available.	
TOTAL	2,540,000	478,000
TOTAL CLASS I AND CLASS II	5,717,000	1,204,000

* If marketed pure, these would fall under Class I: as at present marketed they fall under Class II

† This only comes under this class, if marketed pure.

‡ These cottons only fall in this class, if a regular staple can be evolved.

PART I

CHAPTER II.

The Punjab.

10. According to the latest figures available, those for 1915-16, the area of the Punjab excluding Native States is 60,088,237 acres. The average net area actually cropped for the five years ending 1916-17 was 24,872,000 acres. The average area under cotton for the same period was 1,370,000 acres. The average was, however, considerably reduced by the smaller sowings of cotton in 1915-16, consequent on the heavy fall in prices in the first year of the war. The percentage of the area under cotton to the total area was thus 5·5 per cent. In addition, an average area of 146,000 acres under cotton was returned during the five years ending 1916-17 by Native States in the Province. The percentage of the area under cotton in the Punjab including Native States to the total area under cotton in India for the quinquennium ending 1916-17 was 6·7.

11. The extremes of temperature in the Punjab are very marked, ranging from below freezing point in December and January to a maximum of 116 degrees at Lyallpur and 125 degrees at Multan in May and June. The average annual rainfall which is as high as 35 inches in the north east of the Province, drops rapidly in the west and south and is only 17·73 inches at Lahore, 10·05 inches at Montgomery, and 6·53 inches at Multan. It may be mentioned here that the quality of the *deshi* cotton improves the further westward and southward it is grown. The *deshi* cotton of the Lyallpur district is superior to that of the Amritsar district, whilst Multan cotton is superior to any grown elsewhere in the Punjab.

The soil of the Province is an alluvial loam, generally sandy and fairly uniform in character throughout though local differences occur, the soil of the Lower Bari Doab Canal Colony being, for example, a heavier loam than that of the Lower Chenab Canal Colony.

12. The following are the varieties of cotton which are found in the Punjab :—

Varieties of cotton grown.

- (1) *Gossypium hirsutum*, almost entirely of the Upland Georgian type, now known as Punjab American. From 1918 onwards, at least three-fourths of this crop will be of the type known as 4F and the remainder will consist of a mixture of various American types, including, as in the case of Dharwar American, the variety *G. mexicanum* or New Orleans. This, however, is rapidly disappearing. The length of the staple of 4F cotton is fully $\frac{7}{8}$ th inch and its ginning percentage is 32.

- (2) *Gossypium indicum* (yellow flowered), which is the predominating type of *deshi* cotton throughout the Punjab, except in small tracts in the Western districts. Its staple is $\frac{4}{8}$ ths to $\frac{5}{8}$ ths inch and its ginning percentage 33.
- (3) *Gossypium indicum Mollisoni* (white flowered), which is found in small quantities throughout the Province. Its staple is from $\frac{3}{8}$ ths to $\frac{4}{8}$ ths inch and its ginning percentage 40.
- (4) *Gossypium neglectum*. Of this there are three varieties, *G. N. malvense* (broad lobed leaf) with a staple of $\frac{5}{8}$ ths inch and a ginning percentage of 30, *G. N. verum* (narrow lobed leaf) with a staple of $\frac{4}{8}$ ths to $\frac{5}{8}$ ths inch and a ginning percentage of 35 and *G. N. roseum* (narrow lobed leaf and white flowered) with a staple of $\frac{3}{8}$ ths inch and a ginning percentage of 37.
- (5) *Gossypium sanguineum*. Of this, there are two sub-varieties, one of which has a dark red flower and the other a pink flower. These again are sub-divided into broad and narrow lobed forms. This variety is peculiar to the Punjab and predominates over *G. indicum* in certain parts of the Jhang and Multan districts. Its staple is $\frac{5}{8}$ ths inch and its ginning percentage 32.
- (6) *Gossypium obtusifolium hirsutius* is found only in the Dera Ghazi Khan, Muzaffargarh and Multan districts. Its staple is $\frac{5}{8}$ ths to $\frac{6}{8}$ ths inch and its ginning percentage 33.

Roseum or white flowered *neglectum* is, after *indicum*, the most important variety in the south east of the Province. A high proportion of this and of the other varieties of *neglectum* is found in the Hissar and Ambala districts. Further north and west, *indicum* predominates in the mixture followed by yellow flowered *neglectum*. In those parts of the Canal Colonies in which American cotton is not grown, it forms about eighty to ninety per cent. of the crop. *Sanguineum* is found west of Lyallpur and, in parts of the Jhang and Multan districts, is often grown practically pure. Almost every field of *deshi* cotton in the Punjab contains at least four varieties.

13. Cotton grown under irrigation is generally sown in April though sowings sometimes commence in the latter part of March. In the south west of the Province, they continue up to the end of June or the beginning of July. The unirrigated crop is sown at the end of June or early in July. The seed is either sown broadcast or is dropped by hand behind the plough. Sowing in lines, *i.e.*, with a drill or a plough and marker, has been introduced for American cotton in the Canal Colonies and over 8,000 acres were sown in this way in 1917. Land sown with cotton is levelled and ploughed at least once before sowing but the best cultivators plough two or three times. Some two or three months after sowing, the native plough is run through the crop, practically destroying weeds and, incidentally, some cotton plants. On the whole, the cultivation of cotton in the

Punjab is distinctly inferior to that of wheat. As the proportion of cotton to other crops is low, it follows that cotton is seldom rotated with cotton. It usually follows *toria* (*Brassica campestris*) sugarcane, maize, gram and, less often, wheat. Pickings commence in September and, in the case of American cotton, extend to the end of December, from five to seven being usually taken. The cost of picking works out at about ten per cent. of the produce, the pickers being generally paid in kind and the proportion varying at different times during the season according to the state of the crop. The average outturn in a normal season varies from 80 pounds of lint on unirrigated land to 160 pounds under irrigation. The crop is sold in the form of *kapas*, either to ginning factory owners, who, in the Punjab, are almost invariably cotton merchants or through *dalals* (brokers) to the exporting firms.

14. American cotton appears to have been first tried in the Punjab in 1853, when some seed was distributed by the Deputy Commissioner of Shahpur. Seed obtained from Dharwar was distributed in parts of the Province in 1876 and 1877. The results

History of the introduction of American cotton in the Punjab.

obtained are not on record but the variety known as Punjab *narma*, which was found growing in the Shahpur, Jullundur and Lahore districts in 1902, when serious attempts to introduce American cotton in the Punjab may be said to have commenced, had probably descended from this seed. Work on American cotton, which had begun at Hissar in 1902, was transferred to Lyallpur in 1903. At first, seed was imported from Dharwar but the success obtained up to 1911 was very small everywhere, except in the Jhang district, where many of the cultivators kept their own seed and so secured an acclimatized plant. The policy of importing seed from Dharwar was definitely abandoned in 1912, as it had become evident that the American cotton grown in the Punjab was an improvement on that grown in Dharwar. In the meantime, selection work on American types made considerable progress at Lyallpur. Selections made at the outset by Mr. A. C. Dobbs, then Principal of the Agricultural College and subsequently by Mr. D. Milne, Economic Botanist, were tested on the College farm at Lyallpur and in 1912, as a result of the favourable reports received from the Professor of Agriculture on two of Mr. Milne's selections, Nos. 3F and 4F, it was decided to start seed farms in order to ensure a sufficient supply of pure seed to enable these two varieties to be grown on a large scale. No. 3F, a smooth leaved type was largely a failure in 1913 owing to attacks by jassids, to which No. 4F, a rough leaved Upland type and a selection from the Punjab *narma* mentioned above and not from Dharwar American, proved immune. It was, therefore, definitely decided that work on smooth leaved types should be abandoned and that attention should be concentrated on the 4F variety. The total area under American cotton in the Punjab in 1913 was estimated at 30,000 acres, of which 80 acres were of the 4F variety and 400 acres were of 3F. Since then, the 4F variety has spread very rapidly and, in 1917, out of a total area of 276,000 acres under American cotton in the Punjab, at least 180,000 acres were under it. It is estimated

that in the present season, there are at least 300,000 acres of pure 4 F cotton and between 50,000 and 60,000 acres of other American varieties.

15. The success achieved in introducing American cotton in the Punjab has been so striking and has such an important bearing on the problems of extending the cultivation of long staple cotton in other parts of India that a brief description of the difficulties encountered and the steps taken to overcome them appears called for. The experience of the Agricultural Department in the Punjab shows the necessity for careful experimental work as a basis for progress. The Dharwar American cotton, attempts to introduce which were made at the outset, was a mixture of Upland and New Orleans types and it was not until the Department realized that a rough leaved type of the Upland variety was the only cotton which could be considered safe in the local conditions that any real advance was made. The difficulty, which is everywhere experienced in securing adequate premiums for small quantities of a new variety of superior cotton was specially felt in the Punjab. Up till 1908, the cotton grown under the supervision of the Agricultural Department was sold by private treaty but in that year auction sales were started. These were continued till 1911, when they were dropped for a time as a premium of Re. 1 to Rs. 1-8 was then being obtained in the open market. They were resumed in 1913, as it was considered that a premium of this amount was not sufficient and also that the auction system was necessary to enable sufficient seed of the 4F variety to be obtained for further distribution. A statement showing the progress made by the auction sales will be found in Appendix III. It will be seen that, whilst in 1908-09, there were only two auctions at which a few hundred maunds of cotton were sold at a premium of Rs. 1-5 to Rs. 1-9 per maund over *deshi* cotton as well as other American varieties, in 1917-18, twelve Government and two private auctions were held at which 122,000 maunds of 4F cotton were sold at a premium of Rs. 3-8 to Rs. 5 per maund over *deshi* and Rs. 1-8 to Rs. 2-8 over other American varieties. Full details of the organization of one of the auction sales at which we were actually present are given in Appendix IV. In 1915 and 1916, Messrs. Tata, Sons and Company were the largest purchasers at the sales but in 1917-18, several other big firms such as the Bombay Company, Messrs. Gill and Company and Messrs. Forbes, Forbes, Campbell and Company participated. The fact that the Agricultural Department collects the *kripas* and guarantees its purity enables such firms as these to compete against the local merchants and has led to much higher premiums being secured than was formerly the case. A recent development of great promise has been the starting of private auctions. Two such auctions were held in the Lower Bari Doab Canal Colony at the beginning of this year, one at Okara by Major Vanrenen and Colonel Cole on behalf of the Okara Zamindars' Association, and one at Iqbalnagar by Sardar Jogendra Singh and both may be considered to have been successful. A report on the auction held at Okara will be found in Appendix V.

16. As regards the organization for the distribution of seed in the

Seed distribution.

Punjab the seed from the best cotton sold at the auctions is reserved for the Agricultural Department, which announces the price which will be paid for it at the time the cotton is sold and subsequently supervises the ginning. A premium of two to four annas per maund is paid for seed bought by the Department. The seed, after ginning, is distributed to various agents or *baniyas* (village shopkeepers and money lenders) who act for the Department and are paid a commission of three annas for each maund of seed they sell. Forty-two of these agents were employed last year. In the Lower Bari Doab Canal Colony, the colonization and irrigation officers have given very great assistance in the distribution of seed and in the collection of outstanding dues. The seed is sold at a premium of fifty per cent. over the bazaar price at the time of ginning and it is found that this covers all expenses and leaves a fair margin of profit. No difficulty is experienced in disposing of the seed at a premium as the cultivator is very willing to pay a higher price for seed on which he can rely, and even if the price of seed is five rupees a maund, he can obtain sufficient seed for an acre of land for eight annas. As one of the duties of the Agricultural Assistants and trained fieldmen is to advise the cultivators to uproot any plants of *d'shi* cotton growing amongst American, the crop of the latter is now brought in practically free from any admixture.

17. The Punjab is fortunate in that there are a number of very large

Seed farms.

landholders in the Canal Colonies, who are willing to co-operate with the Agricultural Department in the distribution of pure seed. Amongst these may be mentioned the Military authorities, who have an oathay farm of 20,000 acres at Okara, Colonel Cole and Major Vanrenen who have estates of 7,500 acres each at and near Renala, Rai Bahadur Ganga Ram, C.I.E., M.V.O., who has an estate of 5,000 acres at Gangapur, Mr. H. T. Conville, who has an estate of 3,000 acres at Montgomery and Sardar Jogendra Singh who has one of 2,000 acres at Iqbalnagar. Mr. Conville and Sardar Jogendra Singh have been granted their land on condition that a certain proportion of it is utilized for growing pure seed for the Agricultural Department. In accordance with the present system of seed distribution in the Punjab, ten acres on the Lyallpur farm are reserved for growing selected seed for distribution. Some forty maunds of seed are obtained from this, of which five maunds are sent to the Government seed farm at Montgomery and the remainder is distributed to the estates mentioned above and to other growers who undertake to return the seed produced to the Agricultural Department. As one maund of seed is sufficient for ten acres and as the yield of seed, at a moderate estimate, may be put at four maunds an acre, it follows that the seed supplied from the Lyallpur farm is sufficient for 400 acres in the first year and 16,000 acres in the next year. To produce sufficient seed for 465,000 acres, the ultimate area of which, for the reasons given below, we anticipate will come under American cotton in the course of the next few years, an area of about 11,600 acres is required. Far more than this is available on

the large estates and, so far as American cotton is concerned, no necessity for special seed farms has so far arisen in the Punjab.

18. We have dealt at length in the second part of our report with the commercial aspect of cotton cultivation. The agricultural aspect can be divided into two main heads. The first of these is the question of improving the quality and outturn of the cotton grown. Improvement in quality, *i.e.*, in length and fineness of staple, can only be effected by botanical work. Improvement in outturn can be secured in three ways. In the first place, a strain may be evolved by botanical work, the ginning percentage of which is equal to that of the ordinary varieties but the yield of which is greater. In the second place, a strain may similarly be evolved, the yield of which is equal to that of the ordinary varieties but the ginning percentage of which is greater. In the third place, an increase in outturn may be obtained by improvements in cultivation. The question of the supply of pure seed in sufficient quantities also falls under this head. The second aspect of the agricultural problem is that of extending the cultivation of cotton both in tracts in which it is grown already and in tracts in which it has not so far been grown. As we have already stated, we have no intention of proposing any steps which would prevent the cultivator from growing the crop which pays him best. It is obvious that the evolution of superior strains of cotton of higher value and greater outturn and improvements in marketing arrangements should place cotton in a better position to compete with other crops. Our main concern with this aspect has therefore been to discover whether the reason why cotton is not grown has been that the irrigation facilities with which the cultivator is provided are not sufficient to enable him to grow it. We propose therefore in all provinces to deal with the agricultural aspect more or less in the following order, (1) botanical work, (2) improvements in cultivation, (3) seed supply and (4) possibilities of extension under irrigation.

19. As has already been shown, the botanical work which laid the foundation of the success which has been obtained with American cotton in the Punjab has been selection work on an acclimatized type. We consider that this work should be continued on the same lines and, in paragraph 41 below, have made recommendations in regard to staff which will enable it to be greatly extended. We understand that of twelve new varieties of American cotton which have been handed over to the Professor of Agriculture, two or three are showing great promise. The variety known as 280F, which has been tried for some years on the College farm at Lyallpur is at least $\frac{1}{8}$ th inch longer in staple than 4F but is a poorer yielder and has a lower ginning percentage. 285F, which was only handed over to the Professor of Agriculture last year, is an excellent cotton, even better than 280F, but its yielding properties have still to be tested. We consider that further exhaustive trials should be made with these varieties. It is possible that they may be improved

by further selection. If, however, it is found that their yield is not equal to that of 4F, the question of substituting them for the latter variety will largely depend upon the possibility of their obtaining from the outset the full premium warranted by their superiority in staple.

In this connexion, we would mention that American cotton in the Punjab is at present confined to the Canal Colonies. We consider that the possibility of growing it under well-irrigation in the Eastern Punjab and also under the inundation canals in the south-west of the Punjab should be thoroughly tested, especially if arrangements can be made, in the latter case, to secure the safety of earlier sowings. The evidence submitted to us shows that it stands heavy rainfall better than *deshi*, and in Bihar and Orissa, the type of American cotton known as *buri* is grown with a rainfall of fifty to eighty inches. The heavier rainfall of the Eastern Punjab should not, therefore, be an obstacle to the successful cultivation of American cotton. The testing of its suitability to that tract is work for the Agriculturist rather than for the Botanist, though possibly, the latter might be able to evolve a variety better suited to the local conditions than 4F.

20. As we have already stated in Chapter I, it has been impossible

(b) **Deshi cotton.** for us to confine ourselves solely to long staple cotton. The problems relating to long and short staple cotton are so intermingled that it was inevitable that we should receive a very large amount of evidence in regard to the latter and we feel that we should be guilty of a grave omission if we failed to make recommendations in regard to it. In the Punjab, the energies of the Agricultural Department, both botanically and agriculturally, have been mainly confined to work on American cotton and comparatively little has been done in regard to *deshi*. Surveys of the cottons of one or more districts are, however, carried out annually by the Economic Botanist. The various types have been isolated and comparisons of yield and profit per acre have been made. Selections from the following types have been handed over by the Economic Botanist and are now under trial by the Deputy Directors of Agriculture (1) *G. sanguineum* (broad lobed), (2) *G. indicum*, (3) *G. indicum Mollisoni*, (4) *G. neglectum malvense* and (5) *G. neglectum roseum*. Of these, *G. indicum Mollisoni* and *G. neglectum roseum* appear to be the best in point of yield. In view of the fact that *G. indicum* predominates over the greater part of the province, we consider that efforts should be made to improve it, and to evolve a strain either of this variety or of *G. neglectum malvense* (the staple of which is of about the same length as that of *G. indicum* and longer than that of any other of the indigenous varieties) which would give a better profit per acre than any of the constituents of the mixture at present grown. We are of opinion that the aim in regard to *deshi* cotton should be to obtain a much more uniform staple than is at present the case, say of $\frac{3}{8}$ ths inch in the central and western tracts and of at least $\frac{1}{4}$ ths inch in the eastern tract.

21. The unsatisfactory character of the cultivation of cotton in the Punjab, to which reference has already been made, is reflected in the figures of outturn, the average for both irrigated and unirrigated land being less than in any other province in India, with the exception of Madras and the Central Provinces. We have dealt with the general question of manures for cotton in Chapter XV. In regard to rotations, one of the reasons for the poor cultivation of cotton is undoubtedly that, as compared with wheat, the time available for preliminary cultivation such as ploughing is very limited. This is especially the case when cotton follows wheat and for this reason we consider such a rotation undesirable. The best rotation, in our opinion, from every point of view is cotton after *toria* though cotton after either maize, sugarcane or *senji* (*Melilotus indica*) and maize mixed is a preferable rotation to cotton after wheat. Even more calculated to secure an improvement in outturn than either proper rotations or manures is the general adoption of the practice of sowing in lines and of interculturing. The results obtained on the Lyallpur farm shew the great improvement in yield which can be obtained by the adoption of these methods. In the Punjab, the ordinary seed drills used in Bombay, the Central Provinces and Madras have been adapted to local conditions by the Agricultural Department and modifications have been introduced such as the substitution of metal tubes, cups, etc., for wooden ones. The Agricultural Department has also worked out a simpler method to secure sowing in lines by the addition of a marker to the Indian plough, the seed being dropped in the furrows. For interculture, a new hoe has been evolved based on one in use at Akola. The Gujarat blade harrow which was at first used for this purpose was found unsuitable and the Planet Junior horse hoe, which was bought by some cultivators, is much too expensive for general adoption. Considerable progress has been made in introducing these improvements, and, as already stated, the area sown in lines in 1917, was approximately 8,000 acres. Now that the main difficulties in regard to implements have been satisfactorily solved, we consider that rapid progress may be expected and have no doubt that the energies of the Agricultural Department will be largely directed to this end.

In this connexion, we would mention that we are satisfied that the yield of 4F American cotton is greater than that of *deshi* and that it is less likely to be affected by excessive rain. If we assume the yield to be nearly the same as that of *deshi*, viz., six maunds an acre and the premium obtained to be only Rs. 3 per maund, the extra profit amounts to Rs. 18 per acre. In 1917, the profit was, however, considerably more than this, as the yield was estimated by leading exporting firms at two maunds per acre above that of *deshi*. The fact that yields up to 23 maunds per acre have been obtained on the Lyallpur farm is evidence of the room that exists for improvements in outturn on the ordinary cultivators' fields. Such an improvement must necessarily be a slow process and we do not consider that an increase of more than fifteen to twenty per cent. can be expected within the next ten or fifteen years.

22. As already stated, we do not consider that the establishment in

the Canal Colonies of special seed farms for

Seed farms.

American cotton is called for owing to the existence of so many large estates the services of which can be utilised for this purpose. Such farms will, however, be necessary in order to enable the Agricultural Department to retain control of the seed, should there be any extension of the cultivation of American cotton in other parts of the Province or should superior strains of *deshi* cotton be evolved. We consider it advisable that the question of suitable sites for these farms should be taken up at an early date so that land may be available as soon as it is required.

23. We have dealt at length in Chapter XVI with the general question

**General work on Punjab
American cotton.**

of marketing especially of new varieties of cotton and would only mention here that we consider it desirable that cotton markets should be established in all the well defined cotton tracts of the Province as soon as possible. The Lower Chenab, Lower Jhelum and Lower Bari Doab Canal Colonies appear to us especially suitable for the establishment of such markets. We are also of opinion that the Agricultural Department in the Punjab should aim at the devolution of auction sales to organizations of *zamindars* (landholders), whether in the form of co-operative societies or otherwise, at an early date. The work of seed distribution, both of American and improved *deshi* varieties, should also be devolved on such organizations as far as possible, though we consider that they should work in the closest touch with the Agricultural Department in order that it may retain control over all seed issued. We understand that the Co-operative Department in the Punjab is making a special study of the application of co-operative principles to the problems connected with the production and marketing of cotton and it may be expected therefore that that Department will be able shortly to take over some of the work connected with seed distribution and auction sales from the Agricultural Department. The margin of profit left by the present arrangement for seed distribution is such as to make it a profitable business for co-operative societies. It seems probable, however, that several years must elapse before co-operative societies in the American cotton tract will be in a position to render much assistance in this respect.

24. Of an average area of 1,369,644 acres under cotton in the five years ending 1916-17, no less than 1,070,673

**Prospects of the extension
of long staple cotton in the
Punjab under irrigation.**

acres or 78.3 per cent. were under irrigation either from canals or wells. Irrigated cotton in the Punjab is thus by far the most important part of the crop. The whole of the American cotton crop of the province is grown under irrigation. This is necessarily the case as American cotton requires to be sown in April, except in the south-west where it can be sown up till May 15th, whilst, although April is the usual time for the first sowings of *deshi* cotton, it can be sown up till June and early July. Again American cotton has a longer flowering

and fruiting season than *deshi* and may require watering in October. In these circumstances, any large extension of the cultivation of American cotton in the Punjab, is almost entirely a question of an increase in irrigation facilities. We would mention that there is nothing in the canal rules or procedure to prevent the extension of cotton cultivation and that the water rates levied for cotton are not excessive, being the same as those for wheat. We have, therefore, made an exhaustive examination of the conditions of each irrigated tract in the Punjab in so far as this affects the object of our enquiries.

As the conditions in regard to both climate and water supply differ very greatly in the different tracts we propose to deal very briefly with the prospects of cotton in the area commanded by each canal.

25. It will be convenient to take the canals of the Province in order from east to west. The Western Jumna Canal

(i) **The Western Jumna Canal.**

off-takes from the river Jumna and irrigates the important *deshi* cotton tract of which Hissar is the centre. The river Jumna has a comparatively small catchment area in the Himalayas and is, therefore, more dependent on rainfall than any other river in the Punjab. In consequence, the rise in the river is, on an average, about six weeks later than elsewhere in the Province and the canal does not give a steady supply up to its maximum capacity until the beginning of June, though in early autumn, the supplies are usually good. The largest area of cotton which has ever been grown under the canal was 236,623 acres in 1913-14 and we do not think that, in the present conditions of supply, it is ever likely to exceed 250,000 acres. Although the percentage of the area under cotton to the total area commanded by the canal is greater than on any other canal in the Punjab, we are of opinion that, owing to the late rise of the river, the whole of this tract is bound to remain a short stapled cotton tract unless the Agricultural Department is able to evolve a type of American cotton suitable to the local conditions. So far, comparatively little success has been obtained in this direction on the Hansi farm and we consider, therefore, that the prospects of American cotton in this tract, except possibly to a small extent under well irrigation, may be ruled out. We would mention, however, that, if the Bhakra Dam Project described in paragraph 33 below, is carried out, part of the area commanded by the Sirsa Branch of the canal will be taken over by the present Sirhind Canal, which will then be known as the Upper Sirhind Canal. The water thus made available will also be used in extending irrigation to the unirrigated tracts to the west and south-west of the area commanded by the Western Jumna Canal. We understand that in these tracts, there is a considerable area of heavy (*bhakar*) soil in which American cotton could be grown.

26. The Sirhind Canal off-takes from the river Sutlej and irrigates

(ii) **The Sirhind Canal.**

both British territory and that of the Native States of Patiala, Nabha and Jhind. Although in most years, there is not sufficient water in April to enable the canal to run its full supply, there is usually enough to allow more cotton to

be sown than is at present the case. Normally, the river falls steadily from about the middle of August to the end of October but the supply in the latter month is not far short of the maximum capacity of the canal. In September and October, if the monsoon is poor and the river low, a state of affairs which may be anticipated to occur one year in four, there would probably not be sufficient water to mature large areas of cotton and also to give supplies for *rabi* sowings. The main factor operating against the growth of long staple cotton on this canal is, however, not so much the water supply as the quality of the soil. The western and southern portions of the commanded area are very sandy and are subject to heavy sandstorms, especially in May and June, which seriously damage the young cotton plants. The eastern and northern tracts are more suitable for cotton especially those which lie in the Native States territory. American cotton has been successfully grown in those tracts and it is very desirable that it should be further tried. The largest area of cotton so far grown under the canal has been 84,038 acres in 1913-14 and the average area under cotton during the ten years ending 1917-18 was 41,397 acres. On the basis of these figures, we do not consider that the total area of irrigated cotton under the canal is likely to exceed an average of 50,000 acres in the immediate future and do not anticipate that any appreciable proportion of it will be American cotton. As already mentioned in the preceding paragraph, if the area under this canal is extended as the result of the Bhakra Dam Project, there are some prospects for American cotton in the additional area it will command.

27. The Upper Bari Doab Canal off-takes from the river Ravi. The tract served by it is thickly populated and contains several large towns. In a normal year, the supply in the canal during April is sufficient to permit the sowing of a large area of cotton. As the river drops early and rapidly, the most critical time is the autumn and, as a rule, there is not a sufficient supply after the first week of October to fill the canal to its full capacity. The average area under cotton irrigated during the ten years ending March 1918 was 156,190 acres, the largest area being 234,989 acres in 1913-14. In view of the conditions of supply, we do not consider that the average is likely to exceed 160,000 acres over a series of years. American cotton is at present grown only in the Chunian colony where the area under it in 1917 was 1,257 acres, but its cultivation in that colony and in the immediately adjoining tracts should increase. Except in these areas, the variety grown will, in all probability, remain *deshi* unless the Agricultural Department is able to evolve a suitable type of American cotton. For the purpose of our estimate of the total area of American cotton which may be expected in the Punjab in the next few years, we would adopt a figure of 7,000 acres for the tract under this canal, mainly in the Chunian Tahsil.

28. The remaining five perennial canals in the Punjab,—the Upper and Lower Jhelum, the Upper and Lower Chenab and the Lower Bari Doab—are inter-dependent in the matter of water supply and it will therefore be conve-

nient to treat them together. As their name implies, the Upper and Lower Jhelum Canals off-take from the river Jhelum, and the Upper and Lower Chenab Canals from the river Chenab. The Lower Bari Doab Canal is supplied by the Upper Chenab Canal. Although the Upper Jhelum Canal irrigates the tract through which it passes, its main function is to carry the surplus water of the Jhelum river (after due allowance has been made for the needs of the Lower Jhelum Canal which takes off from the river some twenty miles below Jhelum City) to the head works of the Lower Chenab Canal in order to replenish the supply in the Chenab river, by replacing in it, for use in the Lower Chenab Canal, the equivalent of the water taken out by the Upper Chenab Canal. As in the case of the Upper Jhelum Canal, the irrigation of its own commanded area is not the main function of the Upper Chenab Canal. This is to carry such supplies as may be available from the Jhelum and Chenab rivers with their canal systems to the river Ravi for utilization by the Lower Bari Doab Canal. The designed discharge of the Upper Chenab Canal at the point where it joins the river Ravi is 6,750 cusecs (cubic feet per second), which is also the designed maximum discharge at the head of the Lower Bari Doab Canal. The five canals thus depend for their supplies on the Jhelum and Chenab rivers. The Upper Jhelum, Upper Chenab and the Lower Bari Doab Canals have only recently been opened. The Lower Jhelum and the Lower Chenab Canals have been working for some years and the irrigation on them is fully developed.

In normal years, there is ample water in the Jhelum and Chenab rivers from the middle of March to the end of October to fill the five canals to the maximum capacity for which they have been designed. Almost the whole of the American cotton crop of the Punjab is at present grown on the Lower Jhelum, Lower Chenab and Lower Bari Doab Canals and it is only under these five canals that any great extension of the cultivation of this variety is to be looked for in the immediate future. The largest areas of cotton so far grown on the canals have been as follows :—

Upper Jhelum Canal, 22,306 acres in 1917-18.

Lower Jhelum Canal, 105,168 acres in 1913-14.

Upper Chenab Canal, 31,489 acres in 1917-18.

Lower Chenab Canal, 261,819 acres in 1914-15.

Lower Bari Doab Canal, 138,276 acres in 1917-18.

Until the Upper Jhelum Canal was opened for winter flow, the Lower Jhelum Canal had a copious supply of water throughout the year and the cultivators, therefore, paid little attention to *kharij* (hot weather) cultivation preferring to reserve their energies for *rabi* (cold weather) cultivation. When the irrigation on the Upper Jhelum, the Upper Chenab and the Lower Bari Doab Canals is fully developed and the water supply available is distributed in proportion to the *rabi* irrigation to be done on each, the Lower Jhelum Canal will not get such a copious supply in the winter months as it has done in the past and this should have the effect of stimulating the cultivators to greater interest in *kharij* culti-

vation and should result in a considerable increase in the area under cotton, which, with the exception of sugarcane, is the most profitable of the *kharif* crops. In these circumstances, allowing for the expansion of American cotton at much the same rate as in past years, we are of opinion that an average annual area of 90,000 acres under cotton can be safely anticipated on the Lower Jhelum Canal and that, of this, about 55,000 acres should be under American cotton. For the other fully developed canal, the Lower Chenab, we would place the figures at 245,000 acres and 190,000 acres respectively. After a careful consideration of the climatic and soil conditions of the tracts commanded by the Upper Jhelum and the Upper Chenab Canals and of the area which it is proposed to irrigate in *kharif* under those canals when the irrigation under them is fully developed, we are of opinion that an area of 50,000 acres of cotton may be anticipated on the Upper Jhelum Canal, of which 25,000 acres should be American cotton and that the corresponding figures for the Upper Chenab Canal may be placed at 50,000 acres and 20,000 acres respectively. The Lower Bari Doab Canal tract is not yet fully colonized. Allowing the same proportionate area under cotton in the tract which remains to be colonized as in that in which colonization is complete, we consider that an average area of 180,000 acres under cotton, of which 150,000 acres should be American cotton, is a safe estimate.*

29. Before passing on to consider the prospects of cotton under the

Inundation canals.

inundation canals in the Punjab, we should perhaps explain that an inundation canal is one which has no weir at its head. It is therefore entirely dependent for its supply on the rise and fall of the river from which it takes off, and for this reason, the areas irrigated by inundation canals in the Punjab fluctuate enormously. The rainfall in all the tracts served by such canals in the Province is very scanty.

30. The Sidhnai Canal Series, which consist of the Sidhnai Canal and

(i) **Sidhnai Canal Series.** three inundation canals, off-taking from the Ravi river and irrigating part of the Multan

district, differs from the other inundation canal systems of the Punjab in that the Sidhnai Canal itself takes off from the river above a weir.

*Mr. Roberts wishes to point out on the basis of information furnished by Mr. H. W. Nicholson, Executive Engineer, Ludhiana, that the most recent figures available for the Lower Bari Doab Canal show that the canal is rapidly developing as a first class *kharif* canal. In 1917-18, the mean *rabi* supply was 38 per cent. of the full capacity of the canal and the area irrigated was 339,565 acres or 41 per cent. of the area which it is proposed to irrigate by the canal. The mean *kharif* supply was 42 per cent. of the full capacity and the area irrigated was 296,526 acres or 36 per cent. of the area which it is proposed to irrigate. On the basis of the figures for the Lower Chenab and Lower Jhelum Canals, the supplies in the Lower Bari Doab canal in *kharif* should normally be seventy to eighty per cent. of the full capacity of the canal. If the duty increases proportionately, 64 per cent. of the area which it is proposed to irrigate should be irrigated in *kharif*. The total intensity of irrigation would thus be 105 per cent. without any increase in the *rabi* supplies. It must be remembered that 1917 was an unusually wet year but the figures are instructive as they show the extent to which irrigation can be carried on even with a comparatively small *rabi* supply. He considers that any saving in the *rabi* supplies in the Lower Bari Doab Canal could be utilized in developing canals lower down such as the Sidhnai Canal.

as however, the river from which it draws its supply usually runs dry during the winter, it can only be regarded as a semi-perennial canal. The three subsidiary canals of the series also off-take from the Ravi above the Sidhnai dam but are classed as inundation canals as they do not get water until after the requirements of the Sidhnai Canal have been met. In consequence, supplies in spring and autumn are very uncertain. A satisfactory supply may be available in April or may be delayed until July and, again, the river may run dry early in October or may contain an adequate supply as late as January. The average annual rainfall of the tract served by the canal during the last 28 years has been 6.4 inches only. The uncertainty of the supply is reflected in the figures for the area of cotton which has varied during the last ten years from 2,206 acres to 50,756 acres, the latter being the area in 1914-15. As there is no assured supply during the months of April, May, September and October, which is essential to the successful cultivation of irrigated cotton in the Punjab, no extension of cotton cultivation in this tract can be looked for and we do not anticipate an average area of more than 35,000 acres of cotton over a series of years. Of this, however, 10,000 acres should be American cotton as there are numerous wells in the tract, the supplies in which can be utilized for early sowings and late waterings.

31. The Shahpur inundation canals off-take from the river Jhelum and irrigate part of the Shahpur district. As in the case of the other inundation canals, there are great fluctuations in the area irrigated, that under cotton having varied during the last ten years between 1,339 and 11,582 acres, the latter figure having been reached in 1913-14. The rainfall in this tract is, however, higher than in any other tract served by inundation canals, the average for the 28 years ending with 1917 being 14.14 inches. If conditions continue as at present, no increase in the area under cotton can be expected. Between the inundation canals which make up the Shahpur system there are private canals owned by Tiwana Maliks. As apprehensions were entertained of the effect of the construction of the Upper Jhelum Canal on both the Government and private canals on the left bank of the river, the construction of a branch canal of the Lower Jhelum Canal to be known as the Shahpur Branch was commenced some years ago, the intention being that it should irrigate the whole of the tract at present served by the inundation canals. As the new branch would have been opened about the middle of April and closed about the middle of October, it would have given supplies during the *kharij* season only but these would have been well regulated and assured and not haphazard as at present. It was, however, found impossible to arrive at an agreement with the owners of the private canals as to the terms on which the latter should be taken over by Government and we understand that this difficulty has led to the abandonment of the project. It was suggested to us that the private canals should be left out of the scheme and that the remainder of it, on which a considerable amount of work has already been done, should be completed. As the tract which would be served by the new branch is one which is

eminently suitable for the cultivation of long stapled cotton. we are strongly of opinion that the feasibility of this proposal from an engineering and financial point of view should be thoroughly investigated.

32. The remaining series of inundation canals can be briefly discussed. The Chenab Inundation Canals off-take from the river Indus and irrigate part of the Multan district. The Muzaffargarh Inundation Canals which irrigate part of the Muzaffargarh district, are nine in number, of which six off-take from the river Indus and three from the river Chenab. The Indus Irrigation Canals take off from the river Indus and irrigate part of the Dera Ghazi Khan district. The Sutlej Inundation Canals, which off-take from the river Sutlej are divided into two series, the Upper Sutlej Canals irrigating part of the Lahore, Montgomery and Multan districts and the Lower Sutlej Canals part of the Multan district. The Grey Canals which also take off from the river Sutlej and irrigate about 350,000 acres in the Ferozepore district are not under the Irrigation Department but under the District Board. The average annual rainfall in the tracts served by these canal systems is small, being five or six inches only, except in the tract commanded by the Upper Sutlej Canals, where it is 10.07 inches. In all cases, except that of the Lower Sutlej Canals, the rise in the river from which the canals take off may begin at any time between the beginning of April and the end of May and the fall between the beginning of September and the end of October. In these circumstances, no American cotton can be looked for on any of the canals, with the exception of the Lower Sutlej, unless well-irrigation is used to supplement canal supplies, a point to which reference is made in paragraph 40 below. As the Lower Sutlej Canals usually continue in flow up till about the end of November unless they are eroded by the river below the head, there are some prospects for American cotton under them and it is already being cultivated in the tract which they command. We consider that an area of 8,000 acres under American cotton can be anticipated. As regards *deshi* cotton, after careful consideration of the circumstances of each canal, we would estimate the average annual area over a series of years at about 20,000 acres on the Chenab Canals, 30,000 acres on the Muzaffargarh Canals, 30,000 acres on the Indus Canals, 22,000 acres on the Lower Sutlej Canals, and 40,000 acres on the Upper Sutlej Canals. We are unable to frame any estimate for the Grey canals as no statistics of the average area under cotton on these canals are available.

33. Far more important than the inundation canals from the point of view of the extension of the cultivation of long staple cotton are the irrigation projects at present under consideration in the Punjab and it is, therefore, necessary to examine these in some detail. In connexion with the river Sutlej there are two projects under consideration. The Sutlej Valley Canals Project will utilize the water of the Sutlej to improve the inundation systems on both banks of the river and will protect a considerable area of land at present unirrigated. The land on the right bank of the river is entirely in British

territory while that on the left bank lies mainly in the States of Bahawalpur and Bikanir. In the latter State, there is a considerable area of *bhakar* (stiff loam) soil in the tract which will be commanded. The project provides for two weirs on the Sutlej and four canals, two on each bank. The Bhakra Dam Project will extend irrigation into the Rohtak and Hissar districts in the Western Jumna Canal area. The site proposed for the dam is at the Bhakra Gorge, some forty miles above the point at which the Sirhind Canal takes off from the river. The height of the dam will be 360 feet and the full capacity of the reservoir is estimated at $2\frac{1}{2}$ million foot acres, which will give an average daily draw off of 5,300 cusecs from the beginning of October to the end of April. In addition to extending irrigation to new tracts, the projects will take up all the irrigation at present done by the Upper and Lower Sutlej Inundation Canals and by some of the inundation canals in the Bahawalpur State as well as part of that done by the present Sirhind Canal. The increase in the irrigated area of the Province which will result from their completion is estimated at 3,166,000 acres annually, the increase in the area irrigated in *khari* being over one million acres. On the basis of the experience which has been gained on the perennial and inundation canals in the adjacent parts of the Punjab and of examination of the local conditions, we are of opinion that the construction of the proposed works should result in an additional area under cotton of 325,000 acres, of which not less than 70,000 acres should be American. The Sutlej Valley project affects a tract in which the prospects of that variety are most favourable, provided perennial irrigation can be assured.

34. The Haveli project provides for a weir across the Chenab river below its confluence with the Jhelum from which canals will take off both on the right and left banks. The canal on the left bank, in addition to irrigating a new area between the irrigation boundary of the Lower Chenab Canal and the river Ravi, will supply the Ravi above the Sidhnai dam with sufficient water to include all the irrigation effected both by the Sidhnai and the Chenab Inundation Canals. The canal on the right bank will irrigate the "Kachi" tract of the Jhang district and will improve the conditions of the Karam Inundation Canal, one of the Muzaffargarh series, besides extending irrigation to new areas in the extreme north of the Muzaffargarh district. The culturable area commanded by the project amounts to 1,112,902 acres whilst the area which it is proposed to irrigate annually is estimated at 672,145 acres. The average area matured in the tract during the last fourteen years has been 307,184 acres so that the probable increase on this should amount to 364,961 acres. The tracts which will be served by this project, especially those in the Multan district, are in every way suitable for the cultivation of American cotton, which can be sown up to the middle of May and so considerably later than in the Canal Colonies. The critical time in regard to supplies will therefore be September and October. If a satisfactory supply can be assured during these months, a considerable increase in the cultivation of both American and *deshi* cotton may be confidently anticipated. Estimating on the same basis as in the case of the Sutlej River Projects, we would

place the total cotton area which may be looked for at 100,000 acres, of which 70,000 should be American. We understand that data in regard to the supplies available are still being collected. In view of the great possibilities offered by the tract commanded by this project for the cultivation of long staple cotton, we would urge that the question of the supplies available should be most carefully examined and that the feasibility of supplementing these, if necessary, with water from the river Indus by means of the Sind Sagar Doab project referred to in the following paragraph should be thoroughly investigated. From the evidence submitted to us, it would appear that this should present no difficulty from an engineering point of view. The supplies available for this project will no doubt be supplemented from the supply store by the Woolar Lake project (described in paragraph 36 below) when this is not required for the five linked canals, for which it is primarily intended.

35. The Sind Sagar Doab Project, which is still under preliminary investigation, will probably provide for a perennial canal with a maximum capacity of 10,552 cusecs taking off from the left bank of the river Indus, near Mari and irrigating a large tract in the Mianwali district and smaller areas in the Shahpur and Muzaffargarh districts. It will not take up any portion of the tract irrigated by the Muzaffargarh Inundation Canals. The gross area commanded by flow irrigation will be very nearly five million acres whilst that commanded by lift irrigation will be about 127,840 acres. The culturable commanded area will be very nearly $2\frac{1}{2}$ million acres, exclusive of 63,920 acres which will be irrigable by lift. It is proposed to irrigate annually 75 per cent. of these areas, or about 1,900,000 acres, of which two-thirds will be under *rabi* and one-third under *kharij* crops. The tract commanded by the project is not specially suitable for cotton and we do not think that an area of more than 100,000 acres can be anticipated. The water supply will be ample and therefore some 60,000 acres of this should be American cotton.

36. The Woolar Lake Project provides for holding up some 440,000 foot acres of water in the Woolar Lake in Kashmir which will be used, as required, to supplement the supply in the five linked canals at the commencement of the *rabi* season. It appears improbable that this additional supply will have any effect on cotton cultivation on the five linked canals. When it is not required for these, it could be utilized to supplement the supplies of the Haveli Project and so to improve the prospects of cotton under that Project.

37. The results of our examination of the prospects of American cotton on the various canals, both existing and projected, are summarized in the table below :—

Summary of prospects of American cotton under existing and projected canals.

Canal Area.	<i>Kharif</i> cultivation actual or anticipated.	Total area under cotton anticipated.	Actual area under American cotton in 1917.	Estimated area under American cotton by 1920.	REMARKS.
	Acres	Acres	Acres	Acres	
Upper Bari Doab Canal	570,000	160,000	1,257	7,000	In the Chunian Canal Colony and the surrounding tracts. The area under American cotton in 1917 was all in the Chunian Colony.
Lower Jhelum Canal	220,000	90,000	35,292	55,000	The canal is fully developed. The estimates are based on an examination of local conditions.
Lower Chenab Canal	727,000	245,000	137,200	190,000	The canal was opened in 1891 and is fully developed.
Upper Jhelum Canal	172,400	50,000	3,181	25,000	The area under American cotton is steadily rising.
Upper Chenab Canal	330,000	50,000	8,926	20,000	The canal was opened in 1915 and will take some years to reach its full development.
Lower Bari Doab Canal	410,000	180,000	90,342	150,000	The canal was opened in 1914 and is not yet fully developed.
Sidhnai Canal	105,000	35,000	743	10,000	The canal was opened in 1914 and is not yet fully developed. The tract is very suitable for American cotton.
Lower Sutlej Inundation Canals	95,000	30,000	.....	8,000	A semi-perennial canal but the tract has numerous wells.
Projects.			TOTAL	465,000	Some American cotton was grown in this tract in 1918.
Sutlej River Projects	1,000,000	325,000	...	(Estimated). 70,000	
Haveli Projects	...	100,000	...	70,000	
Sind Sagar Doab Project	633,000	100,000	...	60,000	
			TOTAL	200,000	

It will be seen that we anticipate a total area of 465,000 acres of American cotton under existing canals. We consider this the ultimate area which may be expected in present conditions and are of opinion that it should be reached in two or three years. As stated above, no American cotton can be expected in the near future under the Western Jumna and Sirhind Canals or in the greater part of the area served by the Upper Bari Doab Canal as its success in these tracts depends upon the evolution of a suitable variety and on further experiments which must necessarily take time. No estimates of any value can be made for the inundation canals as though conditions, except in regard to an assured water supply, are in most cases favourable, it is doubtful whether wells will be used for sowing. The total area under cotton anticipated under the three projects shown in the list is 525,000 acres, of which 200,000 acres should be American cotton.

38. It is beyond our province to make any recommendations as to the order in which the projects mentioned above should be taken up as so many factors other than those connected with the cultivation of long staple cotton have to be taken into consideration. We would therefore, merely point out that, as far as the subject matter of our enquiries is concerned, the Haveli and the Sutlej River Projects are the most important. But, although the first three projects we have mentioned will, if carried out, greatly improve the conditions of the water supply to many of the inundation canals and enable long staple cotton to be grown in the tracts they command, they are bound to have a detrimental effect on the supply in the Indus below its confluence with the Chenab. The Sutlej River carries a very small supply in winter so that, although the whole of this will be utilized by the Sutlej River Project, the effect on the supply in the Indus in the winter months will be small. The effect of the Sind Sagar Doab Project on the winter supplies in the Indus will, on the other hand, be considerable as it will draw off 10,500 cusecs. The Haveli Project will not affect the supply in the Indus between October 15th and April 15th. All these projects will, however, affect the supply in the Indus in Sind in spring and autumn very considerably since the full capacity of the proposed canals exceeds 35,000 cusecs. These facts furnish an additional argument for the early construction of the Sukkur Barrage, the importance of which, from other points of view, is emphasized in Chapter VI. Not only is the construction of the Sukkur Barrage and the connected canals far more essential to the extension of the cultivation of long staple cotton in India than any, or in fact, all the projects mentioned above but it is equally essential to the maintenance of the prosperity of Sind at its present level, unless further progress in regard to irrigation in the Punjab is to be stopped in view of its effect upon supplies in Sind. Though the projects under consideration in the Punjab are not so important as the Sukkur Barrage project, they are of very considerable magnitude. We have estimated an area of at least 200,000 acres of American cotton under them. Whilst we trust that it will be practicable to carry them out in the near future, we would again repeat that it is much more necessary that the con-

struction of the Sukkur Barrage should be taken in hand at an early date.* In this connexion, we are of opinion that a thorough investigation into the supplies available in the Indus and other rivers should be carried out, not only with reference to the large tracts of country remaining to be developed in the Punjab but also in Sind. We would here mention that a large increase in the supplies in the Lower Jhelum Canal would undoubtedly somewhat seriously affect the supplies to the Chenab Inundation Canals in the Multan District in May as well as in August and September, judging from the dates on which those canals have been opened and closed in the past. It would also affect the supplies to the Haveli Project in spring and autumn. This difficulty would be obviated if the increased supply were only given in April, if water is then available, and also for the period from June 15th to August 15th. Increased supplies, even for these periods, would permit larger sowings of long staple cotton to be matured. We are unable, however, to offer an opinion as to the feasibility of this proposal from a financial point of view. All that we are definitely prepared to recommend in this connexion, is that a large distributary on one of the existing perennial canals should be selected in consultation with the Agricultural Department to which largely increased supplies should be given during the *kharij* season. In addition to the effect this should have on the area under cotton, it would enable more short season fodder crops to be grown and would stimulate the cultivation of green manure crops. We are of opinion that a greater intensity of cropping is desirable agriculturally, so long as it tends to encourage greater variety of cropping and especially the growing of more leguminous crops. We consider that, looking at the matter from this point of view, the proportion of cereals grown on the Punjab canals is too high but, whilst an increase in the *kharij* supplies would have a beneficial effect in reducing the proportion, as a result of more crops being grown in *kharij*, we do not regard it as likely to decrease the total food production of the Canal Colonies. We would emphasize the fact that, in Sind, cotton is preferred to wheat, whereas on the inundation canals of the Western Punjab, wheat is grown on a much larger area than cotton. This is so because, in the Punjab, wheat can often be matured with only one watering which is not the case in Sind where the temperature during the cold weather is higher. We are of opinion that, with more certain supplies in the Western Punjab, American cotton would probably rival wheat in popularity but the latter will always be an important crop in that part of the Province. We consider that nothing should be done in the matter of increased supplies which is not capable of being repeated on a much larger scale, should the experiment we recommend prove successful. The increased supplies should therefore only be given at the periods when the inundation canals are not ordinarily in flow and again when the supplies in those canals are meeting

* Messrs. Wedia and Hodgkinson would go further than this and are strongly of opinion that the Sukkur Barrage and the canals in conjunction with it are of such great importance that no irrigation project in the Punjab which may affect the supplies of water in the Indus should be undertaken until the Sukkur Barrage project has been carried out or a decision that it should be abandoned has been arrived at.

the demand. As they usually come into flow about the beginning of May and are fully equal to the demand from about June 15th to August 15th, it would be possible to give an increased supply during April and also from the middle of June to the middle of August, when surplus water is flowing unutilized in the rivers. A reduction to the present normal supply would be necessary from the beginning of May to the middle of June but experience on the College Farm at Lyallpur has shown that American cotton does not require water during that period. It would also be necessary from about the middle of August to the dates on which the inundation canals cease to flow unless and until it is found feasible to provide weirs for inundation canal to enable them to be kept in flow to their full capacity when the water in the rivers from which they take off is not high.

We would not recommend that the experiment proposed should be carried out until an agricultural officer is available who can be put on special duty to advise the cultivators on the selected distributary in regard to cropping and rotations but we are of opinion that such an officer should be found as early as possible.

39. Cotton cannot be successfully cultivated in tracts where the subsoil water table is even temporarily within a few feet of the surface. It follows that, in any tract which becomes water-logged or in which the subsoil water table rises within a few feet of the surface, the cultivation of cotton ceases. The rise of the subsoil water table is thus of considerable importance from the point of view of cotton cultivation and we, therefore, made exhaustive enquiries into the question of water-logging in the Punjab and the possibility of its prevention by the lining of canals. Water-logging occurs on nearly all the perennial canals in the Punjab and appears to be due almost entirely to the percolation of water from main and branch canals. The areas water-logged are at present very small in comparison with the areas irrigated. The evidence submitted to us showed, however, that the possibility of an increase in water-logging is regarded with considerable apprehension and that the question both of prevention and cure has engaged the attention of the Punjab Irrigation Department for some years past. Experiments with various kinds of waterproof lining for channels have been carried out on the Sirhind and Lower Chenab Canals but the work was practically stopped at the commencement of the war as the expenditure incurred was not immediately remunerative. Experiments on a small scale are, however, still being conducted and there does not appear to be any danger of this problem, which we regard as of great importance, being lost sight of. The question of lining channels was examined by us from two points of view. In the first place, the stoppage of percolation may be necessary for the continuance of satisfactory cultivation, which means the continued success of the canals. In the second, it may be desirable in order that the water at present lost should be profitably and effectively used elsewhere. The evidence we received was too technical and too conflicting to enable us to come to any definite decision as to which of

these two aspects is the more important and we do not wish to do more than to point out that, in considering the question from the second point of view, both direct and indirect benefits should be taken into consideration. We are inclined to think that the direct benefits such as the land revenue and water rates accruing from the extra areas the irrigation of which would be rendered possible should, at any rate in the case of new canals, be sufficiently substantial to make the lining of canals a practicable proposition. We understand that, in the case of the Bhakra Dam Project, provision has been made for lining the canals, a fact which lends support to our view.

40. The area cultivated under wells in the Punjab is very large. The

Well irrigation.

wells are worked almost exclusively by bullock power at present, the use of power from oil and steam engines being almost unknown. Pumps cannot be used on the existing type of brick-work wells owing to the sandy nature of the sub-soil. A few pumps have, however, been set up in connexion with tube wells and the Punjab undoubtedly offers a very large field for the development of pump irrigation under such wells. Such a development could not fail to have a beneficial effect on the cultivation of cotton as it would provide water for early sowings and final waterings in tracts in which supplies are not at present available for that purpose. Whilst pump irrigation cannot be so cheap as irrigation from canals, it would be cheaper than the present well irrigation and would allow of a considerably larger area being put under cultivation. It would also relieve the pressure on the cattle population of the province, and might assist in solving the problem of water-logging. The hydro-electric scheme now being carried out by the Public Works Department at Amritsar should provide valuable data in regard to the cost of pumping by hydro-electric power but similar data are required in regard to the cost of pumping by means of oil and steam power. We are aware that it is impossible, in present conditions, to obtain machinery and pipes but would strongly recommend that a thorough investigation of the subject should be taken in hand at an early date. We would mention that the possibility of using water power on the Sirhind Canal for pumping purposes was brought to our notice and might also be investigated.

41. There remains for consideration the question of staff required to

Recommendations in regard to staff of the Agricultural Department.

carry out the recommendations in the preceding paragraphs. At present, the Punjab is divided into three Circles for agricultural purposes. The Lyallpur Circle consists of the districts of Lyallpur, Jhang and Montgomery and parts of the Gujranwala and Lahore districts. The Multan, Dera Ghazi Khan and Muzaffargarh districts are included in this circle but, owing to lack of staff, little or no work has been done in them. The circle is in charge of the Principal of the Lyallpur Agricultural College, assisted by a Deputy Director of Agriculture originally appointed for *kalar* reclamation work. In addition there are an Assistant Director and four agricultural assistants for district work. The Gurdaspur Circle comprises all the districts north of

Karnal, Rohtak, Hissar and Ferozepur. It includes the Lower Jhelum, Upper Jhelum and Upper Chenab Canal Colonies and is at present in charge of an Assistant Director of Agriculture, acting as Deputy Director, who also has at present four agricultural assistants for district work. The Hansi Circle comprises the Hissar, Gurgaon, Ferozepore, Karnal, Rohtak and Simla districts and is in charge of a Deputy Director.

We consider it very desirable that the work on American cotton should be controlled from one centre as far as possible and are of opinion that Lyallpur is the most suitable centre for the work. We would therefore add the Upper and Lower Jhelum and the Upper Chenab Colonies to this circle and recommend that Assistant Directors with headquarters at Sargodha and Montgomery be appointed to it at an early date. Selected seed could then be issued from Lyallpur to those two places as sub-centres. We are of opinion that a Deputy Director is required for the south-western part of the Province, comprising the districts of Multan, Dera Ghazi Khan, Muzaffargarh and, possibly also Mianwali. The Deputy Director in charge of this circle should work in close touch with Lyallpur. We consider the formation of this circle a matter of some urgency, in view of the hopeful prospects of American cotton in the tract, especially if any of the three projects which affect it, the Sutlej River, the Haveli and the Sind Sagar Doab Projects, are carried out in the near future. We would point out that, as the tract borders on Sind, any work on American cotton done in it will have an important bearing on similar work in Sind. We consider that the Gurdaspur Circle should be confined to the districts of Gurdaspur, Hoshiarpur, Amritsar and Lahore. This would necessitate an additional Deputy Director for the North East Punjab, a tract in which cotton is not important. At least one additional Assistant Director should be appointed to the new Gurdaspur Circle. The Hansi Circle should comprise only the districts of Hissar, Karnal, Rohtak and Gurgaon. An additional Deputy Director would therefore be required for the Ludhiana, Jullundur, Ferozepore, Ambala and Simla districts, for whom a suitable headquarters would be either Ambala or Ludhiana. The net result of our proposals is therefore the division of the Province into six circles, in five of which cotton is an important crop, and the appointment of three additional Deputy Directors and at least three additional Assistant Directors.

In regard to the botanical work, we are of opinion that an additional botanist with special qualifications in regard to research should be appointed at an early date. The present Economic Botanist is working on American and *deshi* cottons, wheat, dates, potatoes and tobacco and has therefore not been able to give to *deshi* cotton the attention the importance of the crop deserves. The appointment of an additional botanist, whose main work would be on *deshi* cotton, though he would be able to render assistance in the teaching of the advanced students at the Agricultural College, would enable him to devote more time to his very important work on American cotton. An entomologist has already been sanctioned for the Punjab but the post has not yet been

field. We are strongly of opinion that the officer appointed to it should be an agricultural entomologist and not merely a systematic entomologist.

We would add that our proposals are made with reference to work on cotton only and exclude any staff required for special purposes such as *kalar* (alkaline soil) reclamation work or the irrigation research station which we understand is under contemplation. It should be mentioned, in this connexion, that in view of the recommendations in paragraph 203, Mr. Wadia is strongly of opinion that the Principal and professors of the Agricultural College should have no direct connexion with district work and, *vice versa*, that no Deputy Director of Agriculture should hold an appointment at the College as he considers that, under the present system, both College and district work are bound to suffer. The remaining members of the Committee are not prepared to express an opinion on this point as they consider that the Internal administration of the provincial Agricultural Departments and the distribution of work among the officers thereof are matters entirely for the decision of the Local Government.

42. Before leaving the Punjab, we consider it desirable that some mention should be made of the Bahawalpur State, as the evidence submitted to us showed that the prospects of American cotton in that State are exceptionally favourable, provided an assured supply of water can be provided. The State which is situated in the south-west corner of the Punjab has an annual rainfall of six inches only and, in some years, is practically rainless. Cultivation is, therefore, entirely dependent on numerous inundation canals which off-take from the Indus, Chenab and Sutlej. These canals do not come into flow until the end of May and are, therefore, even later than those of the Punjab. They cease to flow at the beginning of October and receive their chief supplies between the middle of June and the middle of September. Irrigation is concentrated on the riverain lands, which are frequently subject to severe flooding by the breaching of the river and canal embankments, a breach in one embankment being followed by that of all those below it. The existing inundation canals command an area of 1,356,292 acres of which about 95 per cent. is cultivable. The average area irrigated during the past five years has been 814,929 acres but, owing to the very unsatisfactory character of the canal supplies, only about 10,800 acres of this were cultivated with cotton, of which nearly 2,000 acres failed to mature.

The greater part of the State consists of waterless uplands known as Cholistan, which are too high to be irrigated by the inundation canals. We understand that the Bahawalpur Darbar has prepared projects for the construction of perennial canals which would take over the tract at present irrigated by the inundation canals and also extend irrigation into Cholistan. The gross area commanded by these projects is estimated at 4,024,160 acres of which 1,986,785 acres will be the commanded cultivable area. The area which will be irrigated annually is estimated at 1,291,410 acres. If a proportion of fifteen per cent. under cotton be

assumed which, in view of the favourable character of the climate and soil, we regard as low, an area of close on 200,000 acres would be under that crop. The proportion of long staple cotton would depend on the water supply available in the month of May. We are not in a position to express any opinion on the feasibility of the irrigation projects proposed by the Bhawalpur Darbar or their relationship to those under consideration in the Punjab but we wish strongly to emphasize the importance of Bahawalpur as a possible tract for the extension of the cultivation of long staple cotton.

43. Our recommendations and conclusions in this chapter may be
Summary. summarized as follows :—

In regard to botanical work :—

- (1) Further experiments should be made with the varieties of American cotton 280F and 285F.
- (2) Efforts should be made to improve the varieties of *deshi* cotton *G. indicum* or *G. neglectum malvense* and to evolve a strain of uniform staple giving a better profit per acre than any of the constituents of the mixture at present grown.

In regard to agricultural work :—

- (3) The rotation cotton after *toria* is the most suitable and its adoption should be generally recommended.
- (4) The practice of sowing in lines and of interculturing is calculated to bring about a considerable increase in the outturn of cotton and the Agricultural Department should endeavour to promote its adoption.
- (5) No special seed farms for American cotton are necessary but such farms will be required if superior varieties of *deshi* cotton are evolved or if there is any extension of American cotton in other parts of the Province. Steps should be taken to select suitable sites for such farms at an early date.
- (6) Cotton markets should be established in the Lower Chenab Lower Jhelum and Lower Bari Doab Canal Colonies.
- (7) The work connected with auction sales of cotton and seed distribution should be devolved on organizations of *zamin-dars*, whether in the form of co-operative societies or otherwise, as soon as possible.

In regard to cotton under irrigation :—

- (8) The possibility of growing American cotton under well irrigation in the Eastern Punjab and also under the inundation canals in the south west of the Province should be thoroughly tested. Experiments should also be made with American cotton in the eastern and northern parts of the area commanded by the Sirhind Canal.

- (9) The possibility of completing the Shahpur Branch of the Lower Jhelum Canal by leaving the private inundation canals in the Shahpur District out of the scheme should be investigated.
- (10) The question of the supplies to the Haveli Project and the possibility of supplementing them by the Sind Sagar Doab Project should be investigated.
- (11) An area of 465,000 acres of American cotton under existing canals and of 200,000 acres under projected canals may be anticipated.
- (12) In view of the effect of the projects under consideration in the Punjab on the supplies in the Indus, it is essential that the construction of the Sukkur Barrage Project in Sind should be taken in hand at an early date.
- (13) A thorough investigation of the supplies available in the Indus and other Punjab rivers should be carried out.
- (14) In order that the effect of increased *khariif* supplies on the cultivation of cotton may be tested, a large distributary should be selected on one of the perennial canals to which greatly increased *khariif* supplies should be given. An agricultural officer should be placed on special duty to advise the cultivators under the distributary in regard to croppings and rotations.
- (15) A thorough investigation of the possibilities of tube wells and of pump irrigation should be taken in hand at an early date.

In regard to agricultural staff :—

- (16) The Punjab should be divided into six circles, for which three additional Deputy Directors of Agriculture and at least three additional Assistant Directors will be required.
- (17) An additional botanist with special qualifications for research should be appointed, his main work to be on *deshi* cotton.
- (18) The officer appointed to fill the post of entomologist already sanctioned should be an agricultural and not a systematic entomologist.

CHAPTER III.

The North-West Frontier Province.

44. The area of the North-West Frontier Province, according to the figures for 1915-16 and exclusive of Native States, was 8,437,733 acres. Of this, the net area actually cropped for the five years ending 1916-17 was 2,308,000 acres, of which only 46,000 acres were under cotton. The percentage of the area under cotton to the total area cropped was 2.0 so that cotton is a crop of comparatively small importance in this Province. The percentage of the area under cotton to the total area under cotton in India, during the five years ending 1916-17, was 0.2.

Statistical.

Climate, soil and varieties of cotton grown.

45. The bulk of the cotton crop of the Province is grown in the Peshawar and Dera Ismail Khan districts. The climate and soil of the Dera Ismail Khan district closely resemble those of the adjacent tract of the Punjab and a detailed description is not therefore called for. The main cotton tract of the Peshawar District lies above the Peshawar Valley and thus escapes the high humidity and frost which characterize the climate of the Valley. The soil, however, is somewhat thin and poor. Very little work on cotton has so far been done in the Province. No survey has been made of the cottons grown and the information in regard to the varieties found and their distribution is therefore extremely scanty. They appear, however, to be much the same as those of the Punjab with the exception of *Gossypium sanguineum*, which has not been reported from the Province. The predominating types are *Gossypium neglectum verum* and *Gossypium neglectum malvense* and the ginning percentage of the mixture is stated to be only 25 to 26. The quality of the cotton produced, especially near Peshawar, is, however, superior to that of the Punjab *deshi* cotton. American cotton has been tried on the Government Farm at Peshawar with indifferent success, as, owing to the high humidity in September and October, the bolls did not open properly and the plants ran to leaf.* It has been grown with much greater success in the Dera Ismail Khan district but only on a very small scale, owing to the want of an assured water supply.

Possibilities of the extension of long staple cotton under irrigation.

46. Of the 26,294 acres under cotton in 1915-16, 16,755 acres were irrigated. As in the Punjab, therefore, the possibilities of long staple cotton depend to a very large extent on irrigation facilities and we propose, as in that province, to deal briefly

*Two American varieties, "Hartsville" and "Mexican Big Boll," are reported to have shown great promise at Peshawar this (1918) season.

with the prospects in the most important canal areas. Of the canals in charge of the Public Works Department, the most important from the point of view of cotton cultivation, is the Lower Swat River Canal which was opened in 1888 and irrigation under which is now fully developed. It takes off from the left bank of the river Swat close to the border, about two miles above the Abazai Fort, and irrigates part of the Peshawar district. Of the average area of close on 160,000 acres irrigated annually during the ten years ending 1915-16, the largest area under cotton was 15,974 acres in 1913-14, when it formed 20·7 per cent. of the *kharif* area. The river rises slowly from about the end of March to the third week in April, when there is usually a rapid rise to the end of May. It begins to fall from about the beginning of August, the fall continuing fairly rapidly until about the end of October. So far there has never been any real shortage of water and consequently no incentive to its economic use. When the Upper Swat Canal tract is fully developed, it is probable that such an incentive will be supplied. Although it is impossible to estimate the prospects of long staple cotton in this tract with any certainty, as no experiments have been made, we do not consider it probable that any thing but *deshi* cotton will be grown in it or that the area under cotton will ever much exceed 15,000 acres unless the Agricultural Department is able to evolve a type of cotton with a better staple and suited to the local climatic conditions.

47. The Upper Swat River Canal takes off from the left bank of the Swat river in tribal territory at Amandara between the Malakand Fort and Chakdara and irrigates part of the Peshawar district. (ii) **The Upper Swat River Canal.** The canal was opened as recently as 1914-15, and irrigation under it is not yet fully developed, 96,000 acres only being irrigated in 1916-17 out of a gross commanded area of 410,571 acres, of which 348,987 acres are to be irrigated annually. The scheme is specially interesting in its political aspect as it offers the inhabitants of the transfrontier tracts an opportunity of settling down to peaceful and prosperous methods of living. Provided colonization of the waste lands can be successfully carried out and an assured supply of water can be obtained, a considerable area of cotton may be expected as the tract appears suitable for *deshi* cotton. The possibilities of American cotton will require to be carefully tested.

48. The Kabul River Canal, which was opened for irrigation in 1903 and irrigation under which is fully developed, (iii) **The Kabul River Canal.** irrigates the Peshawar Valley. Although the average area irrigated annually during the years ending 1915-16 was 41,397 acres, the highest area under cotton was only 1,918 acres in 1912-13. Whilst there is ample water for an extension of cotton cultivation, the tract does not appear suitable either for *deshi* or American cotton, owing to the high humidity and frost which prevent the bolls from opening freely. We do not, therefore, anticipate any increase in the area under cotton under this canal.

49. The Paharpur Inundation Canal takes off from the Bilot Creek of the Indus and irrigates part of the Dera Ismail Khan district. The largest area irrigated by the canal in any one year has been 24,453 acres, the largest area under cotton being 253 acres in 1913-14. The climate and soil of the tract commanded by the canal are very suitable for long staple cotton and the fact that the area at present under cotton is so insignificant is entirely due to the precarious supply in the canal. Not only is it entirely dependent on the rise and fall of the river, but, in its course, it crosses numerous hill streams, floods from which have frequently caused very serious damage and interfered greatly with its working. The feasibility of making it perennial by the construction of a weir or barrage across the Bilot Creek is at present under consideration. If this project can be carried out and a satisfactory supply of water can thus assured, an appreciable area of long staple cotton may be expected. The gross area commanded by the canal amounts to 73,106 acres, of which it was originally proposed to irrigate 63,450 acres annually. On the assumption that the project under consideration enables this estimate to be realised, the area under cotton should be some twenty per cent. of this or about 12,000 acres. There is no reason why the whole of this should not be American cotton.

50. Of the cotton grown under irrigation in the Province, nearly two-thirds are under canals in charge of the Civil authorities, wells and other sources. This area fluctuates very little and such fluctuations as there are, depend mainly on the abundance or scarcity of water in the Bara Canal which takes off from the Bara river and on which the main cotton tract of the Peshawar district depends. There does not appear to be any likelihood of any appreciable extension of the area under cotton in this tract.

51. The superior staff of the Agricultural Department in the North-West Frontier Province consists of one officer only who is designated "Agricultural Officer." Wheat, maize and fruit being the most important crops of the Province, his attention has been mainly devoted to these. We consider that the prospects of cotton especially on the Upper Swat Canal, and if the scheme for making the Paharpur Canal perennial matures, in the Dera Ismail Khan district, are sufficiently important to justify the appointment of a Deputy Director with botanical training to the Province. The first duty of such an officer should be to carry out a survey of the cotton growing tracts and to investigate the possibilities of American cotton in the Upper Swat Canal tract and the Dera Ismail Khan district. It is probable that types both of American and of *deshi* cotton from the Punjab would prove suitable for the former whilst 4F could undoubtedly be grown successfully in the latter, provided an assured supply of water could be obtained. A line of work to which special attention should be paid is selection work on Peshawar cotton as it appears likely that such work would result in a considerable improvement in ginning percentage. We are strongly of

opinion that the officer in charge of the cotton work in the North-West Frontier Province should work in close touch with the Punjab Agricultural Department as many of the problems connected with cotton are common to both Provinces. The Punjab Department should be able to assist him in marketing any American cotton or improved varieties of *deshi* cotton that may be grown and in obtaining for the cultivators a fair price for them. This point is of importance as special efforts in regard to it will be necessary if real progress is to be made. Should our recommendations be accepted we consider that an ultimate area of about 100,000 acres under cotton may be expected in the North-West Frontier Province in six or seven years.

52. Our recommendations and conclusions in this chapter may be
Summary. summarised as follows :—

As regards cotton under irrigation :—

- (1) The possibilities both of *deshi* and American cotton should be thoroughly tested on the Upper Swat Canal.
- (2) If the scheme for making the Paharpur Inundation Canal perennial is carried out, an area of 12,000 acres under American cotton may be expected on that canal.

In regard to staff and lines of work :—

- (3) A Deputy Director with botanical training should be appointed to the Province whose first duty should be to carry out a survey of the cotton tracts and to investigate the possibilities of American cotton on the Upper Swat Canal and in the Dera Ismail Khan District.
- (4) Selection work on Peshawar cotton should be undertaken with a view to obtaining an improvement in the ginning percentage.
- (5) The Agricultural Department in the North-West Frontier Province should work in close touch with the Punjab Agricultural Department in all matters connected with cotton.

CHAPTER IV.

The United Provinces.

53. The area of the United Provinces, excluding Native States, was returned in 1915-16 as 68,303,707 acres. The net area actually cropped for the five years ending 1916-17 averaged 35,683,000 acres, of which 1,239,000 acres were under cotton. The percentage of the area under cotton to the total area cropped was 3·5 and to the total area under cotton in India was 5·6. In addition, the Native States of the Province returned an average area of 13,000 acres under cotton for the five years ending 1916-17.

54. Although cotton is grown almost throughout the United Provinces, the principal cotton growing districts lie in the west, the largest areas being in the Bulandshahr, Muttra, Aligarh and Agra districts. The temperature over the main cotton growing tract, taken as a whole, is higher both in the dry season and during the monsoon than that of the more easterly stations, whilst the rainfall is smaller. The latter varies from about 21 to 40 inches, the monsoon starting in the latter part of June or early in July and ending in September. From the agricultural point of view, the distribution of the rainfall is even more important than its amount and a premature cessation before the end of August is more harmful than a postponement of the first fall to the middle or even the end of July. Excessive rainfall not infrequently causes great damage to the cotton crop. The percentage of irrigated cotton to the total crop, taking the average of the five years ending 1916-17, was 31·3, an almost complete reversal of the conditions in the Punjab. The area of irrigated cotton, however, varies very considerably, having been as high as 646,000 acres in 1913-14 and falling to 230,000 acres in 1915-16. The soil of the main cotton growing tract is mostly the alluvial soil of the Gangetic Plain.

55. With the exception of *Gossypium intermedium* (Tod), and its sub-variety *G. intermedium album*, (staple $\frac{3}{8}$ ths inch to $\frac{5}{8}$ ths inch, ginning percentage 17) which are found in the extreme east of the Provinces and are of no commercial importance, the *deshi* cotton of the Provinces is a mixture of the following varieties, *G. indicum* (staple $\frac{3}{8}$ ths inch, ginning percentage 32), *G. indicum Mollisoni* (staple $\frac{3}{8}$ ths inch to $\frac{4}{8}$ ths inch, ginning percentage 40), *G. neglectum malvense* (staple $\frac{5}{8}$ ths inch, ginning percentage 30). *G. neglectum verum* (staple $\frac{4}{8}$ ths inch to $\frac{5}{8}$ ths inch, ginning percentage 38) *G. neglectum bengalense* (staple $\frac{5}{8}$ ths inch to $\frac{6}{8}$ ths inch, ginning percentage 33) *G. neglectum roseum* (staple $\frac{3}{8}$ ths inch, ginning percentage 38) and

G. neglectum cutchicum (staple $\frac{3}{8}$ ths inch, ginning percentage 36). Of these *G. indicum* and *G. indicum Mollisoni* appear to be only occasionally present. The remainder are found throughout the Provinces but, as no detailed survey has been made of any of the cotton growing districts, it is not possible to frame any estimate of the proportions in which they make up the mixture. *G. neglectum roseum* or Aligarh white flowered cotton is grown pure on about 120,000 acres in the neighbourhood of Aligarh. Practically the whole of the cotton of the Provinces is sold under the commercial name of "Bengals." The staple of ordinary Bengals is from $\frac{3}{8}$ ths inch to $\frac{1}{2}$ th inch, that of "Fine Bengals" being between $\frac{4}{8}$ ths inch and $\frac{5}{8}$ ths inch.

56. Cotton in the United Provinces is sown broadcast as in the Punjab. The preliminary cultivation is usually

Cultivation of cotton.

meagre, consisting generally of two or three ploughings. Except where cotton is grown under irrigation, the soil cannot be worked, as a rule, until rain falls and sowing has then to be done as quickly as possible, owing to the shortness of the season. The crop is generally weeded once by hand. The most usual rotation is cotton after wheat. In the canal irrigated tracts, a mixture of barley and peas is often grown after *deshi* cotton but, owing to its longer season, this is not possible in the case of American cotton and is one of the difficulties against which that crop has to contend. American cotton is only grown under canal irrigation.

57. Attempts to grow long stapled cotton in the United Provinces date back to 1826. In 1841, four of the ten

History of introduction of American cotton in the United Provinces.

planters who had been brought from America by the Court of Directors of the East India Company to promote the cultivation of American cotton in India were allotted to the United Provinces. The experiment proved a costly failure and little or nothing was done until 1870, when, as a result of the appointment of a "Commissioner of Cotton and Commerce" with the Government of India, cotton farms were established at Cawnpore and Allahabad. The experiments with exotics at Allahabad were soon dropped but those at Cawnpore continued and the acclimatized variety of mixed origin now known as Cawnpore American was eventually evolved. Although in his report on the work of the Agricultural Department for 1905-06, Mr. W. H. Moreland, then Director of Agriculture, stated that the American varieties had been proved to be heavy yielders, giving, one year with another, as much as the local varieties and selling at a fifty per cent. higher price, no substantial progress can be said to have been made until 1906, when seed was put out in the Aligarh district. Up till 1909, the practice was for the Agricultural Department to buy in the *kapas* from the cultivators at a premium of Rs. 2 per maund over the ordinary local cotton, to gin it and to dispose of it to the mills, any profit realised after paying expenses being distributed to the cultivators as a bonus. Under this arrangement, the area under American cotton increased considerably. In 1909, however the Government of India objected to the large

advance necessary to finance the crop and, in consequence, little or nothing could be done to assist the marketing of the produce, much of which was sold in the bazaars at a lower price than *deshi* cotton. The result was that the cultivation of American cotton practically ceased for a few years from 1909 onwards. When in 1912, it was decided to resume operations, it was thought better to do so in the neighbourhood of Cawnpore, where no prejudice against it existed. Seed both of Cawnpore American and of Dharwar American was given out but the latter proved unsuitable and the distribution of the seed of this variety was discontinued. From 1912 to 1916, the Agricultural Department made arrangements for the ginning of the cotton and for keeping it separately as well as for disposing of it to the Cawnpore mills, and, by this means, secured a premium over *deshi* cotton of one to two rupees a maund* of *kapas*. In 1917, advances were received from Government which enabled the Director of Agriculture to buy the crop at a premium of one rupee per maund of *kapas* and to institute a modified system of auctions at Cawnpore, under which tenders were obtained from the different mills for the lint, resulting in the realization of an average premium of about Rs. 4-6 per maund of *kapas*. We understand that there has this year been a considerable increase in the demand for seed for sowing and that an area of four to five thousand acres is expected, the largest area so far under this variety.

58. The work on cotton of Mr. Leake, the Economic Botanist in the United Provinces, has been almost entirely confined to the improvement of *deshi* cotton and is described in the following paragraph.

Botanical work—
(a) American cotton.

Botanical work on Cawnpore American cotton in the United Provinces has mainly been done by Mr. Burt, Deputy Director of Agriculture in charge of the Central Circle, who has isolated some very promising varieties which are at present being tested. Mr. Burt is devoting special efforts to the evolution of suitable varieties of a rough leaved type, as experience has shown, as it has done in the Punjab, that they are healthier and less susceptible to insect attacks than smooth leaved types. We consider it advisable that one of these varieties should be put out as soon as possible, in order to render the crop more uniform in staple and quality than is the case at present. In this connexion, we would mention the experiments with the *buri* variety of American cotton which have been carried out by Dr. Parr at Aligarh. These cannot be regarded as having yielded any definite conclusions and we think it would be better if they were abandoned and if the energies of the Agricultural Department in regard to American cotton were concentrated on the Cawnpore American variety.

59. As mentioned above, Mr. Leake has been engaged for some years at Cawnpore on work on the improvement of *deshi* cotton. The problem he has set himself to solve has been to obtain, by crossing on Mendelian lines and by selection

(b) Deshi cotton—
(i) Mr. Leake's work at Cawnpore.

* The Cawnpore maund for transactions in both *kapas* and lint is 100 pounds.

for length and ginning percentage from amongst the crosses so made, varieties of cotton in every way superior to any of their parents. It should be pointed out that the selection in this case is work of a high scientific order and is of an entirely different character from that ordinarily done on the agricultural stations. Many thousands of bolls are picked and labelled and the length of lint and ginning percentage are determined. In this way, varieties with staple of fair length and a high ginning percentage have been definitely isolated. Of these, the variety known as K22 has been reported on by competent trade authorities as having a staple of $\frac{5}{8}$ ths inch whilst the staple of K28 is reported as $\frac{3}{4}$ ths inch. The ginning percentage of K22 is 37 whilst that of K28 fluctuates between 37 and 40. K22 is being tested on a field scale in the United Provinces, Central India and the Punjab and its main characters may be regarded as fixed, though it may, however, still be found lacking in some unisolated character or function which may affect the vigour of the plant or of the seed. It is, therefore, too soon to be able to make a definite pronouncement in regard to its prospects. K28 has only recently been isolated. The evidence submitted to us by the representatives of the Cawnpore mill industry showed that K22 is regarded as a valuable cotton, the production of which in commercial quantities would be welcomed by the trade. Mr. Leake's work is of the utmost importance and interest to the whole cotton world in that it deals with problems of a fundamental character. We are, therefore, strongly of opinion that it should continue on its present lines. At the same time, we think that less scientific methods might produce more immediate results so far as the local problems of the United Provinces are concerned. Notwithstanding the work which has already been done on *deshi* cotton in the United Provinces, to which reference is made in the next paragraph, we consider it highly probable that a detailed survey of the cotton tracts might show the possibility of selecting from the existing crop varieties equal, or nearly equal, to K22 in length of staple and ginning percentage. We would mention that a field selection from Jalaun cotton known as the "Jalaun selection" has been made by Mr. Burt. This is regarded as equal to "Fine Bengals," but we understand that it is not pure. We are of opinion that this selection could probably be given out with advantage, further selection work on it being carried on at the same time, until the Department has satisfied itself that K22 can safely be given out on a field scale.

60. Selection work on the indigenous cottons of the United Provinces was originally taken up by the late Mr. Hayman, formerly Deputy Director of Agriculture who, at the end of some five years' work, recorded the opinion that the only hope of improving them lay in work on crossing. Dr. Parr, who succeeded Mr. Hayman, continued to work on selection and isolated a yellow flowered variety of improved staple. In point of yield and hardness he found, however, that *Gossypium neglectum roseum* now known as "Aligarh white flowered cotton" was the most paying variety, its ginning percentage being 38 to 39 as compared with 33 for the local mixture, its yield, at any rate in dry

years, being superior and its colour whiter. The conclusion at which he arrived was that, although types could be isolated with better staple than that of the ordinary varieties as well as types with higher ginning percentage, it was impossible to obtain a type combining these qualities to an extent which would represent an appreciable advance on existing types. In these circumstances, he almost entirely abandoned work on selection and confined himself to the Aligarh white flowered variety. The extra profit per acre resulting from the cultivation of this variety was estimated by Dr. Parr, before the outbreak of the war, at Rs. 15. This was partly due to the higher yield and partly to the premium obtained for the *kapas* on account of its high ginning percentage and whiter colour. The area under this variety is now estimated at about 120,000 acres. At the outset, it was welcomed by the Cawnpore mills, which did not realize the excessive shortness of its staple, which is barely $\frac{3}{8}$ ths of an inch in length, but the evidence we received showed that it is now regarded with extreme disfavour. The spread of this variety in the tract producing "Bengals" cotton has undoubtedly adversely affected the position of the latter in the market and we consider it desirable that the question whether the Agricultural Department is justified in devoting so large a part of its energies to the spread of this cotton should be re-examined. At present, cotton is bought in up-country markets on its colour, almost entirely irrespective of the length of staple, as the trade regards the staple of all the cotton coming from a particular tract as being the same. A short staple cotton of good colour and high ginning percentage will therefore command a premium for some years until experience in the spinning mills causes its deficiencies to be realized. The trade then reacts against it but such reaction is often unreasonable as it affects not only the particular variety but also other and better varieties grown in the tract from which it comes. Such a reaction appears to have commenced in the case of Aligarh white flowered cotton. Another consideration of great importance in this connexion is that practically no selection work has now been done on the indigenous cottons of the Provinces for some years, and that, in other parts of India such work has proved very fruitful in results. We are, therefore, of opinion that further efforts should be made to obtain an improvement in the ginning percentage of the other varieties of *neglectum* cotton, the staple of which is longer than that of Aligarh white flowered cotton and thus to place them in a position to compete with the latter. We consider it a mistaken policy for the Agricultural Department to promote the spread of that variety until it has been definitely established that no better variety of *neglectum* can be found which will pay the cultivator as well. We understand that, before the war, Aligarh white flowered cotton was mainly exported to the Continent where it was used for mixing with wool. The evidence submitted to us by the Cawnpore mill industry showed that it is by itself of very little value for spinning purposes as it is only capable of spinning up to 6s counts. The demand for it in India, when marketed in a pure state, is very small, and, unless the demand for export revives after the war, it seems probable that the main object for which it will be grown

will be for mixing with superior varieties. We are, therefore, of opinion that the trade demand for it should be very carefully watched and that the policy followed by the Agricultural Department in regard to it should be regulated accordingly. If, as the result of the work on other indigenous varieties and of further experience of the trend of the market, it is found that Aligarh white flowered cotton is more profitable than any other variety, the Agricultural Department will undoubtedly be justified in promoting the extension of the cultivation of this cotton. Even then, we consider it essential that the Department should exercise close control over the distribution of seed in order that it may not spread to tracts which are unsuitable for it, the reputation of which would consequently suffer. We wish here strongly to emphasize that the spread of a short staple cotton to tracts for which it is not suitable and which grow better varieties though with smaller yield and ginning percentage must mean a reduction in the price of the latter and consequent loss to the cultivators, as the trade inevitably suspects contamination and therefore only pays the price of the inferior cotton for all the cotton of the tract. In such a case, the loss in price is not set off by advantages in yield and ginning percentage. It should be mentioned that experience in the Central Provinces and Central India has shown that white flowered cottons suffer more than yellow flowered in years of heavy rainfall and that the proportion of yellow flowered varieties in the mixture increases after such years. It is therefore possible that the experience of the abnormally wet seasons of 1916 and 1917 may be sufficient in itself to bring about a change in the attitude of the cultivator towards Aligarh white flowered cotton. We would add that the organization which has been evolved for the spread of this cotton should prove invaluable when a superior type is available.

61. Whilst we think that the prospects of a considerable extension of the area under American cotton in the United

**General recommendations
in regard to botanical work.**

Provinces are distinctly hopeful, we are of opinion that, in view of the climatic and irrigational conditions of the Provinces, the bulk of the cotton grown in them will remain *deshi*. The main energies of the Department both in regard to botanical and agricultural work should therefore continue to be concentrated on the improvement of the indigenous cottons. We have already recommended that Mr. Leake's important and valuable work at Cawnpore should continue on its present lines. More than this is, however, required if the local problems are to be solved in the immediate future. We consider it essential that a detailed survey of the indigenous cottons should be carried out at an early date, district by district and tract by tract. Until complete information in regard to the varieties grown is available, no solid progress in improving them by the methods usually adopted can be made. Any selections made from the existing crop will start with the advantage that they have, up till now, persisted unaided. Side by side with and subsequent to the survey, selections should be made in the field which should be tested on the farms. We do not consider that the cotton tracts of the United Provinces, taken as a whole, are suitable for cotton appreciably over $\frac{5}{8}$ ths inch in staple

but even if cotton with a uniform staple of $\frac{5}{8}$ ths inch could be substituted for the present mixture, the staple of which varies from $\frac{3}{8}$ ths inch to $\frac{5}{8}$ ths inch, it would represent a great advance.

62. As in the Punjab, there is room for great improvement in the cultivation of cotton in the United Provinces.

Improvements in cultivation. Little can be done in improving cultivation preparatory to sowing and systematic progress can only be rendered possible by the general adoption of the practice of sowing in lines, an essential preliminary to the introduction of which is a detailed study of methods of sowing. We consider that a commencement should be made with irrigated cotton and especially with American cotton which responds rapidly to interculture. The smallness of the holdings and, in many cases, of the fields in the cotton tracts of the Provinces undoubtedly presents an obstacle to the general adoption of the practice of sowing in lines but this should not prove insuperable. As has already been stated a mixture of barley and peas is often grown after *deshi* cotton but cannot be grown after American, owing to the longer season of the latter. In these circumstances, we think that the possibility of growing a fodder crop with both *deshi* and American cotton in September or October should be considered. This is a regular practice in the Punjab, Sind and the North-West Frontier Province, berseem, *shaftal* and *senji* (*Melilotus indica*) being the crops most usually grown and there appears no reason why it should not be adopted in the United Provinces.

63. If there is to be any large extension in the area under Cawnpore American cotton in the United Provinces

General work on cotton. or if superior varieties of *deshi* cotton are to be successfully introduced, the area and number of seed farms will need to be considerably increased, in order to enable the Agricultural Department to retain control over seed distribution. Very large estates are not available for seed farm purposes as in the Punjab and although some use can be made of agencies such as co-operative societies and farms belonging to private owners, it is obvious that the Agricultural Department will still require a considerable area of seed farms if it is to be in a position to supply large quantities of pure seed. As regards the marketing of American cotton, we consider that for the present, the crop must continue to be collected by the Agricultural Department. The difficulty in securing an adequate premium for it should be considerably lessened by the fact that the market for it is a local one and that, for a long time to come, the Cawnpore mills should be able readily to absorb the whole crop. We consider that Cawnpore American is slightly superior to Punjab American in staple and that a premium over *deshi* at least equal to that obtained by the latter variety should therefore be secured for it. At present, the Agricultural Department considers it necessary to buy the *kapas*, to gin it, and to make arrangements for the disposal of the lint as the Cawnpore mills are unwilling to buy the crop in the form of *kapas*. If this system continues, we consider, that, in the peculiar local conditions of the Provinces, owing to which the area under this variety

will probably remain somewhat scattered for a considerable time to come it will be necessary that Government should guarantee to continue to handle the crop until the area reaches about 20,000 acres and the crop about 7,000 bales unless it is found that this work can be taken over by an unofficial agency. We would recommend, however, that the possibility of holding Government auctions of *kapas* on the lines of those which have proved so successful in the Punjab, should be investigated. In regard to the marketing of *deshi* cotton, the evidence submitted to us showed that the cultivator is very much in the hands of the middlemen. The difficulty in establishing cotton markets in the United Provinces, in accordance with our recommendations in Chapter XVI, is that the areas under cotton in those Provinces are not as compact as they are elsewhere. But, although the area under cotton is only 5.6 per cent. of the total cropped area of the Provinces as a whole, it rises to fifteen per cent. in the principal cotton growing districts. Communications are good and it should therefore be possible to establish properly regulated cotton markets on the Berar system in two or three big centres such as Aligarh and Muttra. The establishment of such markets would have an excellent effect in stabilising prices and in enabling cultivators to realize the true value of their produce. We consider that a crop of about 10,000 bales is necessary before a central market can be successfully organized.

64. As has already been stated, 31.3 per cent. of the cotton crop of the Provinces is irrigated and the whole of the American cotton crop is under canal irrigation, which is essential for this variety owing to the length of time for which it is on the ground. Before passing on to consider the prospects of long staple cotton under individual canals as in the case of the other provinces with which we have dealt, we would mention that one of the great difficulties in regard to the spread of long staple cotton under canal irrigation in the United Provinces is that such irrigation rarely extends over the whole of a village and that only a part of the village area can be put under such cotton. In order to meet this difficulty to some extent and to secure more compact areas under American cotton, arrangements have recently been made to concentrate the water supply on certain channels irrigating tracts considered specially suitable for American cotton and to grant additional temporary outlets to cultivators who have expressed their willingness to grow this variety. The information available at present is not sufficient to enable an opinion to be formed as to the results achieved by these concessions and, in these circumstances, it would seem desirable that they should continue for the present until their effect on the area under American cotton can be definitely ascertained. It should, perhaps, be mentioned that, in the United Provinces, all channels are designed to work on a system of rotations, i.e., they are designed to run with a full supply for one week and to be closed the following week. In this respect they differ from the canals in the Punjab and Sind, the channels from

which are designed for constant flow and are worked in rotation only during periods of short supply.

65. The Upper Ganges Canal takes off from the right bank of the river Ganges near Hardwar. It commands a tract the normal annual rainfall of which is 28·67 inches and in which wheat, sugarcane and cotton are the principal crops in order of acreage. Up till 1903-04, the area under cotton never exceeded 71,124 acres but during the ten years ending 1914-15, it averaged 161,555 acres, the highest figure reached being just under 205,000 acres in 1905-06. The Lower Ganges Canal takes off from the right bank of the Ganges at Narora. It commands a tract the normal annual rainfall of which is 30·85 inches and in which wheat, other winter food grains, cotton and rice are the principal crops in order of acreage. Up to 1900-01, the area under cotton never exceeded 6,840 acres, except in 1896-97, when it was 24,464 acres. The average area under cotton for the ten years ending 1914-15 was 139,503 acres, the highest figure reached being 207,778 acres in 1914-15, when cotton formed 46·1 per cent. of the *kharif* irrigation and 18·7 per cent. of the total irrigation for the year. On both canals, indigo proved a serious rival to cotton in 1916-17, but it is, in our opinion, very doubtful whether the competition of that crop will remain at its present level when more normal conditions are restored. The Ganges is a snowfed river, which, as a rule, carries very little water at the beginning of April. It rises very slowly during that month but, in May and June, the rise is more rapid. There is, in present conditions, no great demand during April as the cultivators are busy with the harvest of their winter crop. Only sugarcane and garden crops require water at this period so that no shortage of water has yet been felt. The supplies in the river decrease gradually from the beginning of October. From the evidence submitted to us, it would appear that in normal years there is sufficient water available at the end of April to enable all channels to run in weekly rotation and, after the middle of May, to enable them to run for two weeks out of three. As the sowing of American cotton in the United Provinces can continue until almost the end of May, we see no reason, as far as the water supply is concerned, why there should not be a considerable area under this variety on these canals. Even if the average area under cotton does not exceed that of the last ten years, *viz.*, 160,000 acres on the Upper Ganges Canal and 140,000 acres on the Lower Ganges Canal, this amounts to a total of 300,000 acres. Of this, one-third, or 100,000 acres might eventually come under American cotton, provided the recommendations we have made in the preceding paragraphs result in a sufficiently high premium being obtained to enable this variety to compete against *deshi* cotton. In this connexion, we would mention that the experience of the abnormally wet seasons of 1916 and 1917 in the United Provinces has shown that American cotton possesses a greater power of resistance to rain than *deshi*, a point which should tell in its favour.

66. The Eastern Jumna Canal, which takes off from the left bank of the Jumna near Fyzabad, commands a tract which is too near the Himalayas to be very suitable for cotton, and the maximum area under this crop during the last five years was only 14,621 acres in 1914-15. We are of opinion that the prospects of long staple cotton on this canal may be regarded as negligible as it does not appear very probable that the Agricultural Department will be able to evolve a type suitable to the conditions of climate and water supply.

(iii) **The Eastern Jumna Canal.** 67. The prospects of long staple cotton on the Agra canal which takes off from the right bank of the Jumna river, eight or nine miles below Delhi, are somewhat more hopeful. The average area under cotton on this canal during the ten years ending 1914-15, was 108,369 acres, the largest area being 134,942 acres in 1907-08. The proportion of cotton both to the *kharij* irrigation and to the total irrigation of the year is already high and whilst we do not anticipate that the average area under that crop will exceed that of the last ten years, we think that, as in the case of the Ganges Canals, about one third of this or 35,000 acres might eventually come under American cotton.

(iv) **The Agra Canal.** 68. As statements have been made that a very extensive increase in the cotton crop of the United Provinces will take place as soon as the Sarda Canal is constructed, we think it desirable to mention that the project at present under consideration provides only for the irrigation of a tract in Oudh, in which the area under cotton is small and *deshi* cotton only is grown. We do not therefore anticipate any large extension of the cultivation of cotton either *deshi* or American, even if this project is carried out.

69. The canals in United Provinces are designed to irrigate some forty per cent. of the areas commanded by them which are not irrigated by wells and no supplies are given to any lands for which well water is available. Wells are consequently numerous both in canal irrigated tracts and in tracts in which they are the sole means of irrigation. The Provinces have over a million and half wells actually in use and the area irrigated by them during the five years ending 1916-17 averaged over six million acres, which was two and a half times the average area irrigated by canals. In these circumstances, there is a wide field for the development of pump irrigation, especially in the west and south-west of the Provinces which is the tract most suitable for cotton. The Agricultural Department has installed many tube wells and pumps worked by power during the last few years and has shown that, in most cases, they can irrigate land far more cheaply than bullock power. As in present conditions, it is the exception for the whole of a village to be irrigated from canals and as long staple cotton can only be grown under irrigation, it follows that long and short staple cotton will continue to be grown side by side, with the almost inevitable result of the mixture of seed and lint. We would,

however, point out that no danger of crossing arises from the cultivation of American and *deshi* cotton side by side, as it has been definitely established botanically that American cotton does not cross with indigenous Indian cottons. We consider it desirable to mention this, as we found a somewhat wide-spread misconception on the point. Though long staple cotton could be sown under wells worked by bullock power, it is unlikely that this practice will make any headway, owing to the great amount of water required for preliminary cultivation in the hot weather and the consequent strain on the cattle. From the point of view of long staple cotton, therefore, the development of tube wells and of pumping by power is of very great importance as it would, in many cases, enable whole villages to come under long staple cotton and would solve many of the problems arising from mixing. We would recommend that, as in the case of the Punjab, the question should be thoroughly investigated at an early date. We would point out that, as the areas irrigated by wells in the tracts commanded by canals are not allowed canal water, this would facilitate the introduction of hydro-electric pumping schemes where suitable falls on the canals are available as it would not involve any development of well irrigation at the expense of that from the canals.

70. The Provinces are at present divided into four Circles for agricultural purposes, the Western Circle, the headquarters of which are at Aligarh, the Central Circle, the headquarters of which are at Cawnpore, the North Eastern Circle and the Eastern Circle. Of these, the first three are, in normal times, in charge of Deputy Directors of Agriculture, whilst the Eastern Circle is in charge of an Assistant Director of Agriculture. In view of the fact that the Bundelkhand districts have all a fairly extensive area under cotton and that the best of the *deshi* cotton grown in them is classed as "Fine Bengals," we recommend that these districts should be formed into a separate circle to which a Deputy Director of Agriculture should be appointed. We are also of opinion that, in addition to this, it is essential, if real progress is to be made with cotton in the Western and Central Circles, that the Deputy Directors of those Circles should be given assistance. We consider this preferable to the division of either of those circles beyond that recommended above, partly because it is difficult to suggest any suitable division from the point of view of cotton cultivation and partly because Aligarh and Cawnpore are the two most important cotton centres in the Provinces. We would therefore recommend that an additional Deputy Director should be appointed to each of these Circles. It is, in our opinion, advisable that Cawnpore should remain the centre for work on American cotton for the Provinces and that all work on that variety should be controlled from it.

The United Provinces have at present two Economic Botanists. Mr. Leake is Principal of the Agricultural College at Cawnpore, whilst Mr. Youngman, whose appointment has been sanctioned for a term of five years which expires in 1923, is engaged in teaching work at the

College. We consider it desirable that an additional botanist should be appointed at once, whose main work should be on the *deshi* cottons of the Provinces on the lines we have indicated in paragraph 61 above. Either he or Mr. Youngman could also render Mr. Leake assistance in his special line of work and the arrangements might be reconsidered on the expiry of the period for which Mr. Youngman's appointment has

In view of the ravages of the pink boll worm in these Provinces and the serious effect of this pest on the value both of seed and lint, we are of opinion that the Provinces should have their own entomologist. As in the case of the Punjab, he should be an economic rather than a systematic entomologist, preferably with Egyptian or American experience.

71. Our recommendations and conclusions in this chapter may be *Summary.* summarized as follows :—

In regard to botanical work :—

- (1) One of the varieties of Cawnpore American at present being tested by Mr. Burt should be given out as soon as possible in order to render the crop more uniform in staple and quality than is the case at present.
- (2) The experiments with *huri* should be abandoned and the energies of the Agricultural Department should be concentrated on the Cawnpore American variety.
- (3) Mr. Leake's work at Cawnpore on the improvement of *deshi* cotton should continue on its present lines.
- (4) The selection known as the "Jalaun selection" might be given out at once, further selection work on it being carried out at the same time.
- (5) No further steps should be taken to promote the spread of the Aligarh white flowered variety until it has been definitely established that no better variety of *neglectum* can be found which will pay the cultivator as well.
- (6) A detailed survey of the indigenous cottons of the Provinces should be carried out at once, selections being made at the same time which should be tested on the Government farms.

In regard to agricultural work :—

- (7) A detailed study of sowing methods should be carried out and efforts should be made to promote the adoption of the practice of sowing in lines and of interculture.
- (8) The possibility of growing a fodder crop with cotton in September or October should be considered.
- (9) The number and area of seed farms should be considerably increased.
- (10) The possibility of holding Government auctions of Cawnpore American *kaptis* should be investigated.

(11) The question of establishing cotton markets at important centres such as Aligarh and Muttra should be considered.

in regard to cotton under irrigation :—

- (12) The concessions in regard to water supply at present being granted on certain channels in order to promote the extension of the cultivation of American cotton should be continued, until their effect on the area under that variety can be definitely ascertained.
- (13) An area of 100,000 acres of American cotton on the Ganges Canals and of 35,000 acres on the Agra Canal may be anticipated, provided a sufficiently high premium for this variety can be assured.
- (14) A thorough investigation of the possibilities of tube wells and of pump irrigation by power should be taken in hand at an early date.

In regard to agricultural staff :—

- (15) The Bundelkhand districts should be formed into a separate circle to which a Deputy Director of Agriculture should be appointed and additional Deputy Directors should be appointed to the Central and Western Circles.
- (16) An additional Economic Botanist should be appointed whose main work should be on *deshi* cotton.
- (17) An Agricultural Entomologist, preferably with Egyptian or American experience, should be appointed.

CHAPTER V.

Central Provinces and Berar.

72. The area of the Central Provinces and Berar, according to the latest figures available, those for 1915-16, is
Statistical. 63,966,450 acres exclusive of Native States.

The net area actually cropped during the five years ending 1916-17 averaged 24,985,000 acres, of which 4,475,000 acres were under cotton. The percentage of cotton to the total area cropped was 17·9, a percentage which is higher than that in any other province or in any Native State in India with the exception of Baroda. If the figures for Berar alone are taken, the importance of cotton becomes very much more marked. The percentage of cotton to the total cropped area in Berar in 1914-15 reached the very high figure of 45. The percentage of the area under cotton in the Central Provinces and Berar averaged exactly twenty for the five years ending 1916-17.

73. By far the most important cotton growing tracts of the Provinces are the four districts of Berar and the adjacent
Climate and soil. districts of Nimar, Wardha and Nagpur. The

climate of this tract may be briefly characterised as intensely hot and dry in March, April and May and temperate for the rest of the year. The rainfall varies from 27·61 inches for the Akola district to 46·68 inches for the Nagpur district. The bulk of it is received from the Arabian Sea current of the south-west monsoon, the normal date for the breaking of which is June 10th. The rainfall caused by the advance of the monsoon usually ceases in the second or third week of October, but during November and December, isolated falls are received from the retreating current. The soil of the greater part of Berar is the well known 'black cotton soil,' a rich black and exceedingly fertile loam, often of great depth. The loam of the Nagpur plain, the great cotton growing tract of the Central Provinces, is somewhat shallower than that of Berar.

74. Up till about 1870, the cottons of the Central Provinces and

Varieties of cotton grown. Berar were classified as Chanda *jari*, *bani* or Hinganghat and Berar *jari* or *Oomras*. Chanda *jari* and *bani* were different names for the same variety, which was known as Chanda *jari* when grown as a cold weather crop in the district of that name and as *bani* or Hinganghat when sown in other parts at the beginning of the rains. Berar *jari* or *Oomras* was slightly inferior to *bani*. The name appears to have been applied to all cottons containing a mixture of *bani* and the finer types of *jari*. About 1870, the result of attempts to stamp out the inferior variety of cotton known as

Nagpur *jari*; *kati vilayati* or "old Khandesh," which was found spreading rapidly in Khandesh to the detriment of better cottons, was to drive it into Berar, from which, as the cultivators found it more profitable than the existing varieties, it was never afterwards ousted, in spite of efforts made by Government in 1874 and 1880 to prohibit its cultivation. One of the results of the work of the Commissioner of Cotton described in paragraph 76 below was the introduction into the provinces on a small scale of an acclimatized type of the American cotton known as Upland Georgian. In consequence, the cottons of the Central Provinces and Berar now mainly consist of a mixture, in which varieties of *Gossypium neglectum* greatly predominate. *Bani* (*Gossypium indicum*, staple 1 inch to $1\frac{1}{8}$ th inch and ginning percentage 25) which in its pure state is, perhaps, the finest indigenous cotton in India has almost completely disappeared from the Provinces except as a constituent of the mixture and it is probable that not more than ten thousand acres of it are now grown including about six thousand acres grown as a *rabi* (cold season) crop in Chanda under the name of Chanda cold season *jari*. Upland Georgian (*G. hirsutum*), which is also a long staple cotton, its staple being from $\frac{5}{8}$ ths inch to $\frac{7}{8}$ ths inch and its ginning percentage 31, is not now grown pure. The remaining constituents of the mixture are the various varieties of *Gossypium neglectum*, viz., *G. neglectum malvense* (staple $\frac{9}{8}$ ths to $\frac{7}{8}$ ths inch, ginning percentage 25), *G. neglectum verum* (staple $\frac{5}{8}$ ths to $\frac{9}{8}$ ths inch, ginning percentage 30), *G. neglectum roseum* (staple $\frac{4}{8}$ ths to $\frac{5}{8}$ ths inch, ginning percentage 40) and *G. neglectum cutchicum* (staple ths to $\frac{5}{8}$ ths inch and ginning percentage 38). The average staple of the mixture is $\frac{5}{8}$ ths to $\frac{9}{8}$ ths inch. Its average ginning percentage is 33 in the north of the Provinces where *malvense* and *verum* form a high percentage of the mixture and 35 in Berar where *roseum* and *cutchicum* are found in larger proportions. *G. neglectum roseum* has been isolated by the Agricultural Department and is now grown pure on at least 700,000 acres. It should be mentioned that on the basis of tests carried out at the Imperial Institute, the Director of Agriculture claims that the staple of *roseum* varies from $\frac{3}{8}$ ths inch to 1 inch in length. The evidence we received from other sources does not, however, bear this out and does not justify us in placing the staple at more than $\frac{4}{8}$ ths to $\frac{5}{8}$ ths inch. The cotton sent to the Imperial Institute was grown on the Government farms at Akola and Sindewahi and was not that produced under ordinary cultivator's conditions. *Buri* (*G. hirsutum*), a type of American cotton introduced by the Agricultural Department from the Santhal Parganas about twelve years ago, is grown pure on about two thousand acres. Its staple is from $\frac{3}{8}$ ths to 1 inch in length and its ginning percentage 31. Cambodia (*G. hirsutum* Mill) is grown under irrigation on a small area of the porous, lateritic soils of the Chhattisgarh Division.

75. Practically the whole of the cotton crop of the Central Provinces

Cultivation of cotton.

and Berar is grown without irrigation. Sowing commences in June soon after the break of the monsoon. The land is rarely ploughed unless it has become infested with weeds. It is merely scratched with a blade harrow (*bhakkar*

as a preliminary to sowing. A narrower type of blade harrow is also used for interculture as cotton in these Provinces is usually sown in lines. The usual rotation is cotton and *juar* (*Sorghum vulgare*) in alternate years but cotton is frequently grown for two or three years in succession. Pickings usually commence about the end of October and are over in December, except where cotton is grown under irrigation when they continue till March. Five to seven are generally taken. Except occasionally in the northern districts, cotton in the Central Provinces and Berar is not damaged by frost as it is in the United Provinces and, in these circumstances, the limiting factor is lack of moisture in November and December. The season for crops grown by the aid of rain water only is about 140 to 150 days in length as against 100 to 120 days in the United Provinces and it would appear to be due to this that the varieties of *neglectum* grown in the Central Provinces and Berar are about an eighth of an inch longer in staple than they are in the United Provinces and are also slightly superior to the same varieties in Khandesh.

76. The history of the efforts to grow long staple cotton in the Central

History of efforts to grow long staple cotton in the Central Provinces and Berar.

Provinces and Berar differs from that of the Provinces with which we have already dealt in that these Provinces had already in *bani* a long staple variety of indigenous cotton. In regard to long staple cotton, the problem in the Central Provinces and Berar has therefore been not only to discover suitable exotics, if possible, but also to spread *bani* in parts of the Provinces in which it was not already grown and to prevent its disappearance from tracts in which it was, at one time, produced on a large scale. Isolated experiments with exotics, more especially with Egyptian and Brazilian varieties, date from about 1839. In 1866, a 'Superintendent of Cotton Affairs' was appointed for the Wardha District but, later on in the same year, his duties were absorbed in those of the new post of Cotton Commissioner for the Central Provinces and Berar, of which Mr. J. H. Rivett Carnac was the first and only holder. Seed 'gardens' were established all over the Provinces and various American and Egyptian varieties were given exhaustive trials but with no success. The outturns were small and the staple much weaker than that of the indigenous varieties. Almost from the outset, Mr. Rivett Carnac decided to concentrate his attention mainly on the improvement of *bani* or Hinganghat cotton and to endeavour to effect this by seed selection. His efforts in this direction also failed, and *bani* proved unable to withstand the competition of the coarser varieties. The efforts made in 1874 and 1880, to prevent these from spreading in Berar have already been mentioned. In 1871, Mr. Rivett Carnac became Commissioner of Cotton and Commerce with the Government of India. On his departure, the Cotton Department of which he had been the head ceased to exist, the seed farms were handed over to the Local Administration and interest in the subject rapidly disappeared. As has already been mentioned, almost the only result of his work on cotton improvement was the introduction of Upland Georgian which still survives in the mixture of varieties grown in the Central Provinces and Berar. Experi-

ments both with indigenous and exotic varieties, however, continued on the Nagpur Farm in a somewhat desultory manner. With the re-organisation of the Agricultural Department at the beginning of the century, the question was again taken up and in 1903-04, the seed of acclimatized American Upland Georgian was given out from the Nagpur farm for the first time. The distribution of the seed of this variety continued for three or four years and was then abandoned as it was found that the outturn was less than that of the ordinary *jari* mixture and that the premium obtained over *jari* was not sufficient to compensate for this. In 1904-05 and the following year, large quantities of *bani* seed were purchased by the Agricultural Department and distributed to cotton growers who were to be paid a premium for the lint produced. The seed was bought from ginning factories, arrangements being made to have it carefully ginned. This plan did not, however, prove successful as the cultivators reported that the outturn was inferior to that of their local cotton, *jari*, and refused to continue to grow it. When the *kapas* was brought to the markets, the buyers invariably refused to pay as much for it as they paid for the *kapas* of the *jari* mixture, on account of its low ginning percentage. The system was therefore abandoned after 1905-06, but small quantities of *bani*, *buri*, and *jari* continued to be distributed from the seed farms. In 1907-08, Mr. Clouston, then Deputy Director of Agriculture, began his work at Akola in separating the constituents of the *jari* mixture and in testing their comparative yields and profits. Work on selection and crossing was also undertaken. The result of this work was definitely to establish the superiority of *roseum* to the other varieties found in the mixture both in yield and ginning percentage and consequently in profit to the cultivator. In spite of the fact that *buri* was well reported on in 1908-09, the history of cotton in recent years in the Central Provinces and Berar has therefore been the history of the spread of *roseum* at the expense of all other varieties. The Agricultural Department has, however, continued to do a little work on *buri*, the superiority of which in the small area infested with wilt has become manifest. On other lands it has done fairly well only in years in which the rainfall has been prolonged.

77. The organization evolved in the Central Provinces and Berar for the spread of pure seed of the *roseum* variety

Work on *roseum*. has achieved a success as striking as that obtained by auction sales in the case of 4F in the Punjab and, therefore, merits a brief description. Up till 1912-13, the seed farms in Berar were supplied, as far as possible, with seed from the central farm at Akola, but the progress which had been made by that year had shown that there were limits to the possibilities in this direction. This, combined with difficulties in regard to the provision of the departmental supervision requisite, led to the introduction of an intermediate agency between the Government farm and the private seed grower. A beginning was made with six agricultural unions which were registered as co-operative societies and shortly afterwards some 25 additional unions were formed which were not so registered. The fundamental idea was that the unions should each control about five hundred acres under improved cotton

seed and should each employ and pay for a *kamdar* (fieldman) trained by the Agricultural Department which would supply its available seed to the unions in preference to other purchasers. In 1916-17, the number of unions had increased to 51, of which 25 were registered as co-operative societies and 26 were unregistered. The number of seed farms had increased to 513, some of which are not attached to agricultural unions. The Agricultural Department supplies seed to the central farm of each union, which in turn supplies the branch farms. The organization will be more easily understood from a brief description of the working of a typical union, that of which Rao Sahib B. R. Landge, of Sonvadhona in the Yeotmal district, is the President. The central farm in this case, the area of which is 100 acres, belongs to Mr. Landge. The number of branch farms attached to the union is 35, which is a larger number than is usual and they average about twenty acres in extent. The *kapas* produced is stored by the members of the union, until it can be brought to the union ginnery which also belongs to Mr. Landge. The ginning factory has eight single roller gins. The members of the union have three options in regard to the disposal of their *kapas*, lint and seed. They may get their cotton ginned at the union ginnery and then take away the ginned cotton, storing the seed at the union store-house until they require it. They may sell their *kapas* but retain the seed for themselves, buying it back at the market rate. In this case, the *kapas* must be ginned at the union ginnery. Finally, they may sell either the *kapas* or the lint and seed to any one willing to buy it. The central farm supplies seed to the branch farms at the rate fixed by the Agricultural Department for the seed supplied to it. In 1917, this rate was five rupees per maund of eighty pounds or two and a half times the ordinary market rate for seed. The branch farms sell their seed to outsiders at this rate. The Tahsildar usually assists in the disposal of the seed. The union employs a *kamdar* (fieldman) on Rs. 12 per mensem to supervise the work on the central and branch farms. His main duties are to see that plants of varieties other than *roseum* are 'rogued out' and to assist in the distribution of seed. The ginning rate charged was Rs. 4-10 for ten maunds, i.e., 280 pounds of lint.

The work of the agricultural unions is co-ordinated to a large extent by the Taluk Agricultural Associations of which there is one in almost every *tahsil* in the cotton growing tracts of the Central Provinces and Berar and of which the leading members of the agricultural unions are also members. In order to enable these Associations to carry out useful work, it is necessary that they should employ paid workers and some District Boards have already made them grants for this purpose. The intention is that each Taluk Association should ultimately be in a position to employ a trained Agricultural Assistant. The work of the Taluk Associations is linked up by the Central District Associations. It should be mentioned that seed distribution is only one, though it is at present the most important, of the functions of the agricultural unions and Taluk Associations which are engaged in other work connected with the furtherance of agricultural development such as the sale of improved implements and manures.

It should be added that *roseum* seed sufficient for nearly 200,000 acres was distributed direct by the agricultural unions in 1917. As has already been stated, the total area under *roseum* is now estimated at about 700,000 acres and is thus about one-sixth of the total cotton area in the Central Provinces and Berar. In addition to this, there is now a very much higher proportion of *roseum* in the ordinary *jari* mixture.

In regard to the working of the unions, the only points on which comment is called for are that there does not appear sufficient justification for the high rate charged for seed and that the unions will not be able indefinitely to continue to sell seed as at present as the tracts in which they are situated should soon produce practically pure *roseum*.

78. We are inclined to think that the Agricultural Department in the Central Provinces and Berar has devoted its

Botanical work. energies in recent years too exclusively to the spread of *roseum*. Whilst we fully admit that the success it has achieved in this direction has been such as largely to justify the adoption of this course and wish to record our high opinion of the organization it has evolved, we are of opinion that the spread of *roseum* should have been regarded as a preliminary step only and not as an end in itself. We consider that the ultimate aim should have been the evolution of a superior type of *neglectum* cotton with a staple of $\frac{3}{4}$ ths inch and a ginning percentage of about 35. We have no desire to underrate the value of the work on selection and crossing which has been done, but we are of opinion that, in view of the complexity of the cotton problems in the Central Provinces, such work required the specialized knowledge and the full time of an Economic Botanist. When these become available, there is nothing in the conditions in the Central Provinces and Berar to prevent work of this character from being as successful as it has been in other parts of India. We therefore consider that further selection work should be done on the better types of *neglectum* cotton such as *malvense* or *verum* or on *bani* (*indicum*) with a view to obtaining longer staple and higher ginning percentage and we hold the view that there is a promising field for investigations in this direction. The cross between *bani* and "deshi Lahore" (probably *indicum*) known as the "Sindewahi cross," which has a ginning percentage of 35 to 36 and is the only type with any pretensions to staple remaining out of the many crosses made, appears to be still unfixed and has only been tested at Akola. We are of opinion that the efforts of the Department to introduce *buri* on a large scale were rightly abandoned. Although there is some scope for this variety in areas infected by wilt, such areas are estimated at not more than about one or two per cent. of the cotton area of the Provinces and experience all over India has shown that American types have only succeeded on light soils which have a well distributed rainfall or are under irrigation, conditions which are not fulfilled by the cotton growing tracts of the Central Provinces and Berar. Whilst, therefore, we consider that the work on cotton in these Provinces has, in the main, been carried out on sound lines, we would strongly emphasize the necessity for further intensive work on the improvement of the staple of the indigenous

cottons. Work on cotton in the Central Provinces and Berar is of special importance, not only on account of the large area under that crop in the Provinces themselves, but also in view of the great, though indirect, effect it exercises on the adjacent cotton tracts in Central India and the Nizam's Dominions.

79. The implements used for interculture in the Central Provinces and Berar answer their purpose satisfactorily on the whole, but require to be supplemented by an implement which will break up the soil thoroughly towards the end of the rains, so as to leave a loose mulch between the rows of cotton. The Agricultural Department has introduced an improved hoe, known as the Akola hoe, for this purpose and about one hundred of these are sold annually. Efforts should be made to spread the use of this implement as rapidly as possible. It has been found that the cotton crop in the Central Provinces and Berar responds to nitrogenous manure and there is some reason to believe that the use of nitrate of soda, if it could be obtained at the rates prevailing before the war, would prove profitable to the cultivator. We do not, however, consider that, in present conditions, any appreciable increase in the yield of cotton can be expected unless a leguminous fodder crop of high yielding capacity which could be grown either instead of or with *juar* can be introduced and we consider it desirable that further experiments in this direction should be made. As has already been stated, the usual rotation is cotton and *juar*. The introduction of another crop in addition to *juar*, which would mean a three year rotation, would have the effect of reducing the area under cotton and, for that reason, in view of the high prices of cotton at present prevailing, it is not likely to prove acceptable to the cultivator. If the present prices continue, they should, however, permit of the use of artificial manures and of improved implements which the cultivator should be easily able to afford and should thus lead to heavier yields being obtained.

80. The evidence submitted to us showed that the usual premium obtained by *roseum* cotton in its unginned state over the ordinary *jari* mixture of Berar is Rs. 3 per *khandi* of 560 pounds or less than eight annas per maund of eighty pounds. This premium is due to the higher ginning percentage of *roseum* and it would, therefore, be expected that the lint of the longer stapled *jari* cotton would fetch a higher price than that of *roseum*. This, however, is not the case and we were informed that the price of the lint of *roseum* is usually higher by one or two rupees per *bhoja* of 392 pounds than that of *jari*. This somewhat curious fact can only be explained on the assumption, which our enquiries throughout India showed to be correct, that cotton is bought upcountry almost entirely on class and grade, no attention being paid to staple. As the lint of the *roseum* variety is always cleaner than that of any of the other *neglectum* cottons, owing to the way the bolls open, the result is that small quantities of it fetch higher prices than the lint of *jari*. But even

if it be assumed that the lint of the two varieties sells at the same price, it follows that, as the ginning percentage of *jari* is 35 whilst that of *roseum* is 40, the latter should fetch Rs. 137 per *khandi* of 560 pounds of *kapas* when *jari* is selling at Rs. 120 per *khandi*. The actual premium is, however, only three or four rupees. This, in our opinion, appears to show that a superior variety of *neglectum* with a higher ginning percentage than the present *jari* mixture would not find the competition of *roseum* quite so severe as is usually anticipated. As regards the extra profits per acre, the table below which is based on figures supplied by the Director of Agriculture shows the relative values of the varieties *roseum* and *verum*.

Variety.	Percentage of lint.	Average outturn of <i>kapas</i> on the cultivators' fields.	Outturn of lint.	VALUE.
		lbs.	lbs.	
<i>Roseum</i> . .	40	320	128	Rs. 68-9 at Rs. 120 per <i>khandi</i> of 560 pounds.
<i>Verum</i> . .	32	275	88	Rs. 59 at Rs. 117 per <i>khandi</i> of 560 pounds.

The difference per acre in favour of *roseum* is thus Rs. 9-9. Much higher differences than this have, however, been claimed.

In this connexion, we should mention that the field tests of the different varieties which have been carried out by the Agricultural Department have not been made under conditions exactly comparable with those which obtain on the fields of the ordinary cultivator. Although these tests have been made on plots on which cotton has been grown in succession for eleven years, owing to superior soil and excellent cultivation, yields have been obtained which are from eighty to one hundred per cent. above the average of the tract. Whilst we consider that the tests may be regarded as giving a correct indication of the relative yields of the different varieties, the matter is one which affects a large tract in which soil conditions differ considerably and we are therefore of opinion that duplicate tests on a more extensive scale are desirable. Such tests are especially necessary in the Nagpur tract, in which conditions are somewhat different from those in Berar.

81. Whilst it is obvious that figures such as those given in the preceding paragraph render the question of the possible substitution for *roseum* of a variety with longer staple a very difficult one, we would invite a reference to our remarks in regard to Aligarh white flowered cotton in paragraph 60 above. The position in the Central Provinces and Berar differs somewhat from that in the United Provinces in that *roseum* has a slightly longer

staple than Aligarh white flowered cotton and is also grown on a very much larger area. At the same time, we consider it not improbable that if the result of our recommendations is that all the cottons of India are marketed in a purer state, this may react unfavourably on the price of *roseum*. There is also no doubt that, in normal times one of the principal uses of *roseum* is for admixture with wool on the Continent and the war may bring about considerable changes in this respect. In these circumstances, we are of opinion that, as in the case of Aligarh white flowered cotton, the trend of the market should be carefully watched and that the policy of the Agricultural Department should be regulated accordingly. Whilst we consider that, for the present, the work of the Department in connexion with *roseum* should continue on existing lines, we regard it as essential that it should endeavour to evolve a superior variety of *neglectum* or *indicum* cotton of sufficiently high yield and ginning percentage to enable it to compete successfully with *roseum* either in the conditions now prevailing or in the event of the demand for the latter showing any tendency to fall off. If this is found impossible and if further experience shows that *roseum* continues to give a higher profit per acre to the cultivator than *jari*, we should be in favour of vigorous measures to cover the whole of the cotton tracts of the Central Provinces and Berar with this variety. The organisation which has been built up for the spread of *roseum* should prove invaluable in spreading any superior variety that may be evolved. In this connexion, we would mention that the Central Provinces and Berar have already a system of markets which, in chapter XVI, we have recommended for general adoption as well as one for seed distribution which leaves little or nothing to be desired. We have, therefore, no recommendation to make under these heads except that we consider it desirable that the Department should continue to be in a position to supply pure seed of the *buri* variety for use in wilt infected areas.

82. As we have already stated in paragraph 78 above, experience all over India has shown that American types of cotton have only succeeded on light soils which have a well distributed rainfall or are under irrigation. The soils in the Central Provinces which best answer to this description are the light porous lateritic soils, known as "*bhata*" soils of the Chhattisgarh Division in the east of the Central Provinces. Cambodia cotton has been grown under irrigation with great success on the Government farm at Chandkuri near Raipur and on cultivators' lands in that neighbourhood and it is estimated that there will be 1,000 acres under this variety at the end of this year. The two canals which command considerable areas of *bhata* soil are the Mahanadi and the Tandula. The Mahanadi canal takes off from the Mahanadi river fifty miles south of Raipur, the supply being supplemented by a storage reservoir of 8,000 million cubic feet capacity upon one of the tributaries of the river at Maramsilli. The canal is designed to irrigate 400,000 acres and, in 1916-17, the second year of its working about 70,000 acres took water. The Tandula canal, a project which depends for its supply on a storage consisting of two large lakes connected by a cutting and

impounding 9,000 million cubic feet of water, is designed to irrigate a tract west of and adjacent to that commanded by the Mahanadi canal. It is anticipated that 277,000 acres will be irrigated and that the system will probably be completed in 1920. Surveys recently carried out have shown that roughly 44,000 acres of *bhata* lands suitable for cotton can be commanded by existing works, mainly by the two canals just mentioned, and 6,000 acres by new projects at present under investigation, a total of 50,000 acres for the whole Province, of which all but 4,000 acres are in the Chhattisgarh Division. In view of the necessity for rotating other crops with cotton, it does not appear probable that more than one-half of this or 25,000 acres at the most will eventually be available for the cultivation of that crop. All the irrigation works in the Central Provinces are dependent on the monsoon rainfall for their supply and are intended to ensure the safety of the staple crop which is rice. In the case of the Mahanadi canal, it would appear that the supply will be ample for the area under rice even in very bad years and that water will be available for the 14,000 acres of *bhata* land commanded by that canal, of which, for the reason given above, 7,000 acres might come under cotton. The Tandula canal is less favourably situated and it is questionable whether the existing supply will suffice for the area under rice. Additional storage would therefore have to be provided for the 25,000 acres of *bhata* land commanded by that canal. We understand that an investigation into this question is about to be taken in hand but that it is doubtful whether additional storage can be secured except by tapping the catchment area of the Mahanadi Canal which would necessitate the construction of a connecting canal and therefore prove very costly. The position therefore appears to be that if provision could be made for additional storage in the Mahanadi catchment area, there would be ample water after the monsoon for the whole of the *bhata* lands commanded by the Mahanadi and Tandula canals. Matters are in altogether too undeveloped a stage to enable us to offer any opinion as to the area which might eventually come under Cambodia cotton in this tract. We consider that an area of 7,000 acres is all that can be anticipated in the near future, but that, judging from experience at Chandkuri, this should all be excellent cotton from one inch to 1½ inch in staple. Whilst we realize that cotton must always remain a secondary consideration in this tract, we would urge that, as far as financial and other considerations permit, efforts should be made to provide water for as large an area of *bhata* land as possible. We would add that, should the cultivation of long staple cotton in the Chhattisgarh Division prove sufficiently profitable to make pumping a practical proposition, the area available for cotton cultivation could be greatly increased. We understand that, in the case of the Mahanadi Canal, additional storage could be made available to supply irrigation by pumping to about 150,000 acres of *bhata* land in the tract commanded by this canal. In the tract served by the Tandula Canal, there is also a large area which is at present uncommanded but could be irrigated by pumping. As already stated, however, the construction of a connecting canal would possibly make this too costly. We would

therefore recommend that an investigation into the possibilities of pumping should be undertaken in due course. In connexion with Cambodia, we would mention that there appear to be possibilities for this variety as an unirrigated crop on the black soil areas of Western Chhattisgarh where the rainfall is high and the soil rather light. The Agricultural Department recently started a farm at Kawardha in this tract, for which we recommend that the suitability of Cambodia should be thoroughly tested.

83. The Central Provinces and Berar have a sanctioned staff of three Deputy Directors of Agriculture and three Assistant Directors of Agriculture. The latter

Recommendations in regard to staff.

are members of the Indian Agricultural Service and not, as in other Provinces of the Provincial Service. At present, nearly all these posts are vacant owing to the absence of officers on military duty and to difficulties of recruitment. We understand that the Local Administration has recently submitted a scheme for a considerable expansion of the superior staff of the Agricultural Department. This scheme does not affect the cotton tracts which form the present Western Circle and would, in normal circumstances, have a Deputy Director and an Assistant Director under the existing arrangements. Whilst we do not recommend an immediate increase in the staff proposed for these tracts, we would express our entire concurrence in the view of the Local Administration that the cotton tract should before long have two Deputy Directors to itself, one for the eastern and one for the western portion. We are strongly of opinion that it is desirable that a second Economic Botanist should be appointed to the Provinces at an early date. The work of the present Economic Botanist has been mainly on *juar* (*Sorghum vulgare*), rice and wheat and though it appears possible that he may be able to give more time to cotton in the future than he has done in the past, we consider it advisable, in view of the very great importance of the cotton crop in these Provinces and in the adjacent Native States, that a botanist should be appointed who should devote his whole attention to it. His work on the indigenous cottons should proceed on the lines we have indicated above, whilst in regard to Cambodia in Chhattisgarh, he should undertake selection work on the lines which have been followed at Cawnpore and Lyallpur, the importation of seed being stopped as soon as possible.

84. Our recommendations and conclusions in this chapter may be summarized as follows :—

In regard to botanical work :—

- (1) Selection and hybridization work on the better types of *neglectum* such as *malvense* and *verum* and on *ban-indicum* should be carried out with a view to the evolution of varieties with longer staple and higher ginning percentage.
- (2) Selection work on Cambodia should be carried out on the lines followed at Cawnpore and Lyallpur.

In regard to agricultural work :—

- (3) Efforts should be made to spread the use of the Akola hoe.
- (4) Experiments should be made in regard to the possibilities of growing leguminous crops either with or instead of *juar* in the ordinary rotation of cotton and *juar*.
- (5) Duplicate tests should be carried out on an extensive scale especially in the Nagpur tract, with a view to ascertaining with absolute definiteness the comparative yields of *roseum* and other varieties.
- (6) The trend of the market in regard to the price of *roseum* cotton should be carefully watched and the policy of the Agricultural Department should be regulated accordingly. If it is found impossible to evolve a superior variety of *neglectum* or *indicum* or a cross between them which can compete successfully with *roseum* in the matter of profit to the cultivator, vigorous measures should be taken to cover the whole of the cotton tract of the Provinces with that variety.
- (7) The Agricultural Department should continue to be in a position to supply pure seed of the *buri* variety for use in wilt infected areas.
- (8) The possibilities of Cambodia as an unirrigated crop on the black soil areas of Western Chhattisgarh should be investigated.

In regard to cotton under irrigation :

- (9) An ultimate area of 7,000 acres under Cambodia cotton on the *bhata* lands of the Chhattisgarh Division may be expected in the near future.
- (10) As far as financial and other considerations permit, efforts should be made to provide water for as large an area of *bhata* land as possible.
- (11) The possibility of irrigation by pumping as a means of extending the cultivation of long staple cotton on the *bhata* lands should be investigated in due course.

In regard to agricultural staff :—

- (12) An Economic Botanist should be appointed to the Provinces who should devote his whole time to work on cotton.

CHAPTER VI.

Sind.

85. As the cotton problems of Sind are entirely different from those of the remainder of the Bombay Presidency

Statistical.

of which it forms a part for administrative purposes, and are more akin to those of the Provinces with which we have already dealt, it will be convenient to treat Sind as a separate unit and to take it in advance of the Presidency proper. According to the figures for 1915-16, the area of Sind, excluding Native States, is 30,098,076 acres. The net area actually cropped during the five years ending 1916-17 averaged 4,138,000 acres, the culturable waste averaging 5,954,000 acres and the current fallows 5,164,000 acres. Of the net area actually cropped, rather less than 50,000 acres were unirrigated. These figures are eloquent testimony to the extent to which the Province is dependent on the waters of the Indus. The average area under cotton for the ten years ending 1916-17 averaged 268,000 acres, exclusive of an average of 7,000 acres returned from the Native State of Khairpur, and was 6·5 per cent. of the net area cropped. The percentage of the area under cotton in Sind to the total area under cotton in India for the five years ending 1916-17 averaged 1·2.

86. Practically the whole of the area under cotton in Sind is concentrated on the left bank of the Indus in the

Climate and soil.

districts of Nawabshah, Thar and Parkar and Hyderabad. The Province is almost rainless as it receives an average of two inches only in July and August and less than two inches during the rest of the year. The temperature is subject to great fluctuations. During the cold months from October to March, the thermometer frequently falls below freezing point at night and the days are cool and pleasant. In the hot months, the dry heat is intense, reaching a maximum of 126 degrees Fahrenheit at Jacobabad. The soil is an alluvial loam, similar to that of the Punjab but generally of a somewhat stiffer texture. In many tracts, it is akin to that of the Egyptian delta. It will be obvious from the figures given in the preceding paragraph that the whole of the cotton crop is grown under irrigation.

87. The *deshi* cotton of the Province consists of a mixture of the same varieties as those grown in the Punjab

Varieties of cotton grown.

with the addition of *Gossypium neglectum cutchicum* and the exception of *Gossypium sanguineum* and need not therefore, be further described. The average length of the staple of the mixture, in which *Gossypium neglectum* greatly predominates, is $\frac{3}{8}$ ths to $\frac{5}{8}$ ths inch and its average ginning percentage 35. Sind cotton is con-

siderably rougher in texture, stronger in staple and whiter in colour than that of the Punjab. The best cotton is grown in the Hala sub-division of the Hyderabad district. The average yield of *deshi* cotton in a favourable season is said to be as high as 800 pounds of *kapas* per acre, a very much higher yield than in the Punjab where the average under irrigation does not exceed 520 pounds. In addition to *deshi* cotton, there are areas, which at present are insignificant, under American cotton (*G. hirsutum*). Egyptian cotton (*G. barbadense*) is not now grown except on the Government farms.

88. Cultivation in Sind is notoriously inefficient. The bulk of the land is in the hands of fairly big *zamindars*, who let it out in blocks to cultivators, known as *haris*, who are yearly tenants, and have thus little interest in the land. The *zamindar* supplies the seed, ploughs, cattle and labour, divides the crop and pays the assessment out of his share of it, after recovering the value of the seed advanced. Much evidence was submitted to us in regard to the indolence and backwardness of the *haris*, which were represented as constituting a serious drawback to progress but which, in our opinion, are the almost inevitable result of the system on which they hold their land. The methods of cultivation adopted are of a very primitive type. Rotation of crops is unknown and the implements used are of the roughest pattern. Two bullocks generally draw the clumsy native plough, while a heavy log of wood does duty for a harrow. A most important factor in the system of cultivation in Sind is the practice of fallowing, which results in only one-third of the land being cultivated annually, the remaining two-thirds being left fallow. This practice is said to be immemorial and the additions to and improvements in the irrigation system of the Province which have been made since the advent of British rule have only stereotyped it. It is recognized in the Standing Orders of the Bombay Government, under which the assessment on occupied land is only payable for the years in which it is cultivated wholly or in part, unless the land has paid no assessment for four consecutive years, when assessment becomes payable on it in the fifth year, whether it is cultivated or not. It can, however, only be regarded as a relic of primitive methods of agriculture and could not have survived except in a province in which there was a plenitude of land, scarcity of water and a sparse population, conditions which always favour extensive cultivation. Even on the Jamrao Canal which came into being in 1900 and is regarded as the most up-to-date canal in Sind, an intensity of irrigation of $33\frac{1}{3}$ per cent. which means a proportion of one-third irrigated to two-thirds fallow, was considered suitable.

89. Experiments with exotics in Sind date from 1846, when a few maunds of seed were supplied from Bombay to Dr. Stocks, the Conservator of Forests, for trial at Shikarpur in the Sukkur District. The experiment proved a failure owing to the brackish nature of the water used to irrigate the cotton. Desultory experiments in other places

were carried on until 1852 when Sir Bartle Frere, then Commissioner in Sind, pointed out that no definite or useful result was likely to follow from them and urged that some practical man should be appointed to devote himself actively and entirely to work on cotton. Mr. Prince was therefore transferred from Coimbatore to Sind. Under his supervision, Egyptian, New Orleans and Sea Island cotton were cultivated in several places but with little success, the yield being poor and the cotton much discoloured and dirty. On his death in 1854, the experimental establishment was abolished and nothing further was done until 1868, when farms were opened near Hyderabad and Karachi. The experiments on the farms and elsewhere led to no definite result and it was not until after the opening of the Jamrao Canal in 1900 that the question of cultivating exotic cotton in Sind can be said to have been taken up in real earnest. Mr. M. D. Mackenzie, then Deputy Commissioner of the Thar and Parkar district, succeeded in raising such good crops of Egyptian cotton that, in 1904, a farm was opened at Dharo Naro in Thar and Parkar, the work on which was transferred to Mirpurkhas in the same district towards the close of the year. In 1904, some 31,000 pounds of Egyptian seed were distributed to selected cultivators on the Jamrao Canal. The outturn which only amounted to 1,500 bales proved very disappointing and so did the price obtained for it, which for the *Abbassi* variety was 7½d. per pound of lint and for the *Mitaffifi* variety 5½d. per pound against 10d. and 9d. respectively in Liverpool. It is worthy of mention that, at this stage, an outturn of 100,000 bales of Egyptian cotton from Sind was anticipated in the course of a few years. This estimate was based on the fact that the total area cultivated on the two canals in Sind which were regarded as perennial, the Jamrao and the Fuleli, amounted to 620,000 acres in all, 270,000 acres under the Jamrao and 350,000 acres under the Fuleli. It was considered that there was no reason why one-third of the annual cultivation on the two canals should not consist of Egyptian cotton and that an outturn of half a bale per acre would be a conservative estimate. In 1906, the British Cotton Growing Association reported most favourably on the quality of the Egyptian cotton in Sind and expressed its willingness to buy all the cotton grown from Egyptian seed. By 1909, however, it had become evident that the water supply in Sind was too uncertain to make the prospects of the successful cultivation of Egyptian cotton at all hopeful. The supply in the Jamrao Canal in 1907 and 1909 was deficient whilst, in 1908, the canal was altogether closed at the proper time for sowing. The Agricultural Department, therefore, turned its attention to American cotton as this required a shorter season than Egyptian cotton and was, therefore, more likely to prove suitable to the irrigation conditions in Sind. Several varieties of American cotton, including Triumph, Black Rattler, Griffin, Texas Big Boll and Boyd's Prolific were tried and it was decided that Triumph was the most promising. Forty tons of Triumph seed were accordingly imported in 1912 and were distributed in 1913, ten tons going to Upper Sind and the remainder being given out in Lower Sind. The inundation season was, however, very late

and very little of the seed was sown. The total outturn was only 511 bales, of which 500 came from Lower Sind. The crop was purchased by the Bombay Syndicate which had been formed in 1912 to co-operate with Government in the disposal of the American cotton grown in Sind. In 1914, the total outturn of American cotton was estimated at 650 bales, of which 100 bales came from Upper Sind. About half of this was purchased by Messrs. Ralli Brothers as the Bombay Syndicate had delayed quoting their rates. In 1915, the crop fell to 560 bales all of which was produced on the Jamrao Canal. The greater part of it was purchased by Messrs. Ralli Brothers as the operations of the Bombay Syndicate were suspended. The outturn in 1916 was insignificant as the seed had been badly mixed in the ginneries the previous year and it was decided to give out pure seed only, very little of which was available. In 1917, owing to the closure of the Jamrao Canal for silt clearance in April and May, practically no American cotton was grown in Sind except on the Government farms.

90. We consider that the experiments with Egyptian and American cotton in Sind though they have, for the time being, ended in failure show, beyond doubt, that these varieties can be successfully cultivated in the Province. We are emphatically of opinion

Causes of failure of Egyptian and American cotton in Sind.

that the fundamental cause of failure has been the unsatisfactory character of the irrigation. Provided a perennial supply of water can be assured, we hold the view that there is no other part of India which offers such hopeful prospects of the successful cultivation of long staple cotton. The climate and soil are, in every way, most suitable and all that is wanted is water at the right time and in sufficient quantities. Whilst irrigation difficulties have been the main cause of the failure of Egyptian and American cotton in Sind, it is necessary to point out that there have been other contributory causes. In the case of Egyptian cotton, one of these was the difficulty of obtaining seed. The practice was to import seed of the *Abbassi* and *Mitaffifi* varieties from Egypt. It would, in our opinion, have been a sounder policy to make selections from the *Mitaffifi* variety actually grown in Sind and to stop the importation of seed. Similarly in the case of American cotton, all the evidence we have received shows that imported varieties only succeed in India after acclimatization and it would therefore have been better if instead of importing seed of the *Triumph* variety on a large scale, more continued efforts had been made to evolve a strain of that variety adapted to local conditions. The other causes which contributed to the failure of exotic cotton in Sind, poor cultivation and the fact that the full value of the cotton was never received by the cultivators, were, in our opinion, the inevitable consequences of the unsatisfactory nature of the irrigation facilities. Until a perennial supply of water is assured, cultivation is not likely to improve. As we have pointed out in Chapter XVI, the operations of the Bombay Syndicate proved unsuccessful, mainly owing to over sanguine estimates of an immediate increase in the area under American cotton which were, in turn, based upon an altogether too optimistic view of the capacity

of the Jamrao Canal. The failure of the outturn to come up to expectations naturally led to difficulties which were accentuated by the fact that the cultivators were under no obligations to dispose of such cotton as they had to the Syndicate.

Prospects of long staple cotton in Sind. 91. Holding, as we do, the view that the provision of an assured water supply is absolutely essential to the cultivation of long staple cotton in Sind, we cannot too emphatically express our opinion that unless such a supply can be secured, the efforts of the Agricultural Department to promote the spread of American or Egyptian cotton in Sind are merely a waste of time and that the correct policy for that Department to follow should be to concentrate its attention on the improvement of *deshi* cotton. The only canal in Sind at present, on which conditions approach those of perennial canals, is the Jamrao and it is on that canal that by far the greater part of the American and Egyptian cotton crops of the Province has, so far, been grown. Although we were told that there is no great likelihood of the Jamrao Canal being closed again for silt clearance for another ten years, which means that American cotton might be grown on it with some prospect of success for that period, the past history of that canal has not been such as to justify us in placing the slightest confidence in this estimate. All the witnesses appearing before us who were questioned on the point agreed that another failure of the canal would mean the end of American cotton in Sind for the time being and might make its revival difficult, should perennial irrigation ever become an accomplished fact. In these circumstances, we propose to depart somewhat from the order we have adopted in the other Provincial chapters as our recommendations are necessarily based on the assumption that the Sukkur Barrage Project, which is described in detail below, will be carried out in the near future. Unless it is, we see no hope for long staple cotton in Sind, and should the ultimate decision be to abandon the Project, we are of opinion that all attempts to promote the cultivation of long staple variety in the Province should also be given up.

Irrigation system of the Province. 92. Before passing on to consider the project known as the "Sukkur Barrage Project" for providing perennial irrigation for a very large tract in Sind, including almost the whole of the area in which cotton is at present grown, it seems desirable to give a brief description of the present irrigation system of the Province. The Jamrao Canal and the Eastern Nara Canals System which comprises the large Mithrao Canal and the smaller Eastern Nara, Thar Hiral and Khipro Canals depend for their supply on the water of the Nara River, an ancient course of the river Indus, which is fed from the Indus through a twelve mile cut, excavated in 1858-59, known as the Eastern Nara Supply Channel and taking off from the Indus near Rohri. The Jamrao and Mithrao Canals are considered perennial canals as weirs have been constructed across the Nara river at the points at which they take off from it. There is a regulator at the head of the Nara river but there is no way of forcing

supplies into it when the parent river is low. In consequence, the canals only get a small supply from autumn to spring and of this the Jamrao has a claim to two-thirds, the remainder going to the Eastern Nara System. In these circumstances, the classification as perennial of the Jamrao and Mithrao Canals, especially of the latter, the supplies to which are even less satisfactory than those to the Jamrao, hardly appears justified. The only other canal in Sind, which has any pretensions to being regarded as a perennial canal, is the Fuleli Canal which takes off from the river Indus near Hyderabad and has no less than 1,015 miles of main canal and branches. Although it is in flow throughout the year, the supply is very low except in the inundation season and water along the greater part of it has to be raised by lift. It was not inaptly described to us as being a river rather than a canal. As in the case of the Jamrao, this canal is occasionally closed for silt clearance, the last closure being in 1912. The area of cotton under it has never exceeded 25,000 acres. The chief factors which operate against its extension are, in the south, the competition of rice for which, owing to flooding, the tract is alone suitable and, in the north, the difficulty of obtaining water sufficiently early for sowing. Of the canals, which are indisputably inundation canals, the Begari, Ghar and Western Nara Canal Systems take off from the right bank of the Indus in the order named, the Begari Canal System above Sukkur and the other two below it. The Shikarpur Canals take off from both sides of the Indus above Sukkur but mainly from the left bank. The Nasrat and Hyderabad Canal Systems take off from the left bank of the river between Sukkur and Hyderabad. The inundation canals in the Karachi Canals District, which form the southernmost system, take off from both banks of the river, not far from its mouth. As their name implies, all these systems are entirely dependent on inundation from the river Indus for their supplies. They usually come into flow about the beginning of June and cease to flow during September but this does not mean that they get a full supply during that period. Full supplies are actually run for thirty to forty days only. For this reason, the inundation system is more suitable to rice than to cotton on account of the shorter season of the former crop. The position at present is that, given a sufficient water supply, the Sindhi cultivator will always cultivate rice in preference to cotton but that, in tracts in which the water supply is restricted, he prefers cotton to any other crop. In the south of the Province, this preference for rice is accentuated by the fact that very large areas are flooded during the inundation season owing to inability to control the water supply at the heads of the canals. Sufficient has been said to show the unsatisfactory character of the irrigation everywhere in Sind, the result of which is that, up till now, practically nothing but short season and therefore short staple cotton has been grown. Even on the Jamrao canal, the supply is not sufficiently assured to make long staple cotton a certain crop. Owing to very small supplies during the winter months, it is found impossible to close the canal during these months for inspection and any repairs that may be necessary. The canal is therefore usually closed when the demand for water

slackens after the wheat crop has been matured and these closures, as has already been pointed out, are fatal to the cultivation of long staple cotton, which requires to be sown early. We are thus brought back to the proposition which has already been laid down, namely that the chief, if not the only, factor which governs the extension of long staple cotton in Sind is an assured water supply. It is true that a considerable increase in the agricultural population of the province is almost equally necessary but provided the water supply could be secured, this should follow, especially if the questions arising out of the land system of the Province can be placed on a satisfactory footing. We understand that there are very considerable areas of waste land in the tracts commanded by the Sukkur Barrage Project which could be made available for colonization but that difficulty may arise owing to the fact that somewhat shadowy rights over them are claimed by the *zamindars* whose lands they adjoin. This is not a subject on which we are competent to express an opinion but, in view of its important bearing on the prospects of the Barrage Project, we would recommend that it should be investigated at an early date by a strong Committee. It appears obviously undesirable that it should be left in its present unsettled state.

93. The fact that a project for assuring an ample and steady supply of water for a very large tract, comprising almost the whole of the area in Sind at present growing cotton, has been prepared and is under consideration has already been mentioned. Mainly owing to differences of opinion as to whether it should include a "barrage" across the river Indus, no decision has yet been reached in regard to it. The project at present under consideration provides for a barrage across the Indus near the Sukkur-Rohri Gorge, a canal from the right bank of the Indus which will take over the irrigation now in the Ghar and Western Nara Canals Districts and a canal, to be known as the Rohri Hyderabad Canal from the left bank of the Indus, which will take over the irrigation in the Nasrat and Hyderabad Canals Districts and will also irrigate part of the tract commanded by the Fuleli Canal. It also provides for improvements to the Jamrao Canal and the canals of the Eastern Nara Canals District. We made careful enquiries regarding this project for, as we have already emphasised more than once, unless some such scheme is carried out, there is, in our view, no prospect of anything but an insignificant area under American or Egyptian cotton in Sind. The evidence submitted to us showed that there is a consensus of opinion that the barrage is an essential part of the scheme and that it would be very dangerous to proceed with the construction of the canals unless the barrage is built at the same time. We have no hesitation in endorsing this view. We understand that it would be possible to construct the proposed left bank canal without the barrage. With this canal and with the improvements to the Jamrao and Eastern Nara Canals we are more especially concerned, as these canals would command the only important cotton growing tracts. We entirely concur, however, in the opinion expressed by all the witnesses who were examined on

the point that it would be most inadvisable to stake the prosperity of so large a tract of country and the well-being of thousands of cultivators, their families and cattle on the working of the canal unless an absolutely certain supply of water could be guaranteed, which would not be the case unless the barrage were constructed. It need hardly be pointed out that whilst the construction of the barrage and canals is absolutely essential to the cultivation of long staple cotton in Sind, it would have the much more important effect of transforming some four and a half million acres of culturable land, at present sparsely populated and indifferently cultivated, into one of the richest and most productive tracts in India.*

94. As has been stated in the preceding paragraph, the proposed canal taking off from the right bank of the Indus would take up all the irrigation in the Ghar and Western Nara Canals Districts. This tract is especially suitable for rice, of which an excellent quality is cultivated commanding in the bazaar double the price of the coarse red rice of Lower Sind. The area under cotton is very small, the average for the five years ending 1915-16 being only 600 acres out of a total of 877,508 acres irrigated. The substitution of cotton for rice would therefore involve a radical alteration in agricultural practice and though such an alteration may come about naturally, when the cultivator finds that, as the result of an assured supply of water, cotton is as safe a crop as rice, we consider it safer not to anticipate any appreciable area under cotton in this tract.

95. The tract to be served by the proposed canal on the left bank of the river Indus which, as already stated, will take over the irrigation in the Nasrat and Hyderabad Canals Districts as well as part of that under the Fuleli Canal, is already a 'dry' crop tract, *i.e.*, one in which the cultivation of rice is severely restricted by the refusal of water for it, partly with a view to economy of water and partly with a view to the prevention of waterlogging, from which the tract at the end of the Fuleli Canal suffers so badly. The result is that *juar* (*Sorghum vulgare*), *bajra*, (*Pennisetum typhoideum*) and cotton are the principal *kharij* crops. During the five years ending 1915-16, the average area under cotton was 115,987 acres out of a total area of 558,855 acres, exclusive of 20,698 acres in the whole of the Fuleli Canal District. The cultivators under the Nasrat Canals prefer *juar* and *bajra* to cotton whilst, under the Hyderabad Canal, *bajra* is the favourite crop. The reason for this is that those crops have shorter seasons than cotton and their period of growth synchronizes more closely than that of cotton with the period during which there is a good water supply in the canals. Provided a satisfactory water supply is assured throughout the year and the restriction on the cultivation of rice is maintained, as we consider that it should be, there is every reason to believe that cotton would

* In connexion with the subject matter of this paragraph, *Vide* Messrs. Wadia and Hodgkinson's footnotes on page 27.

become the most popular *kharif* crop and that the area under it would amount to about half the area actually irrigated in the tract as is very nearly the case in normal years on the Jamrao, even in present conditions. The total culturable area on the proposed left bank canal is estimated at about 2,132,000 acres, of which it is proposed to irrigate fifty per cent, annually. Half the area irrigated annually would, therefore, be 533,000 acres. We have examined the revenue reports on the Project and are of opinion that an area of 400,000 acres may be regarded as a very safe estimate of the area under cotton which may be anticipated on this canal and that, on the analogy of the Punjab, at least 250,000 acres of this should grow long staple cotton of excellent quality.

96. The Jamrao Canal District is also one in which the cultivation

(iii) **The Jamrao Canal.** of rice is restricted and in which in consequence 'dry' crops only are grown. Though this canal has a weir and head works and has thus a more assured supply than any other canal in Sind, the Nara river from which it takes off is subject to floods and heavy silting. We understand that embankments are now under construction to exclude river floods from the Indus but, though it appears probable that, when these are completed, there will be no further trouble of this nature, it is doubtful whether the assured and ample supply of water from April to November, which is required for the successful cultivation of long staple cotton, can be secured except by the improvements which will result from the construction of the Sukkur Barrage. During the five years ending with 1915-16, an average area of 108,154 acres was under cotton out of a total area of 245,767 acres irrigated. The proportion under cotton would have been almost exactly one half, had it not been for the closure of the canal for silt clearance in 1916-17, which reduced the area under cotton to one half that of the previous year, whereas the area under *bajra*, which, as mentioned above, requires a shorter season than cotton, very nearly doubled as did that of wheat. On the assumption that all the waste land under the canal will be occupied, the total culturable commanded area will be 676,000 acres. The main improvement which would be brought about by the construction of the Sukkur Barrage would be that at least fifty per cent. of this would be irrigable instead of thirty-three per cent, as at present. There is no reason why the present proportion of cotton to the total irrigable area should not hold good in the future, in which case an area of 169,000 acres under that crop may be safely anticipated, of which not less than 100,000 acres should be long staple cotton.

97. The Eastern Nara Canals District is essentially a rice tract

(iv) **The Eastern Nara Canals.** though the quality of the rice grown is very poor, the cultivation being especially primitive and slovenly. During the five years ending 1915-16, the average area under cotton was 36,768 acres out of a total area irrigated of 257,032 acres, and of this the larger part was on the Mithrao Canal. The unsatisfactory character of the supplies in 1916-17 was reflected in this

case, as in that of the Jamrao, in the figures for cotton, the area under which was 14,611 acres only against 47,821 acres in the previous year. The evidence submitted to us showed that this tract is likely to develop at a much slower rate than the remainder of the area affected by the Sukkur Barrage and that it would be some fifteen or twenty years before the maximum area under cotton would be reached. The proportion of cotton to other crops would probably not be as high as on the Jamrao Canal and we would not anticipate an area of more than 90,000 acres under cotton, of which 50,000 acres should be long staple.

98. The examination of the prospects of long staple cotton in the tract affected by the Sukkur Barrage Project, which has been made in the preceding paragraphs, shows that the following areas under cotton may be anticipated as the result of the construction of the barrage and the left bank canal and the improvements to the Jamrao and Eastern Nara Canals.

Summary of prospects of long staple cotton in areas affected by the Sukkur Barrage.

	acres
Rohri Hyderabad Canal	400,000
Jamrao Canal	169,000
Eastern Nara Canals	90,000
A TOTAL OF	659,000 acres,

against an average area of 260,909 acres for the five years ending 1915-16, exclusive of 20,698 acres under the Fuleli, part of the area now irrigated by which will, as already mentioned, be included in the tract commanded by the Rohri Hyderabad Canal. Of the total area of 659,000 acres of cotton estimated above, an area of at least 400,000 acres made up as follows, should be under long staple cotton :—

	acres.
Rohri Hyderabad Canal	250,000
Jamrao Canal	100,000
Eastern Nara Canals	50,000
TOTAL	400,000

We would here point out that this is not a case in which it is proposed to open up new country which was the object of the great Punjab canals. The tract which is affected by the Sukkur Barrage is the most settled and the most populous part of Sind. The effect of the barrage will be to substitute large perennial canals for a net work of small inundation canals and to convert irrigation by lift into irrigation by flow over large areas. The new canals will enable large tracts of land already occupied to be cultivated more intensively than at present and should in course of time, reduce the necessity for fallowing to a minimum.

99. It is unnecessary to deal at any length with the remaining canal systems of the Province as, in present conditions of supply, there is no prospect of the successful cultivation of either *deshi* or long staple cotton under them and there are no projects under contempla-

tion for improving them. The tract which will be left under the Fuleli Canal after the construction of the Sukkur Barrage is more suitable for rice than for cotton and we do not anticipate that the area under the latter crop will exceed 20,000 acres on an average, all of which will be *deshi* cotton. The average area under cotton on the Berari Canals for the five years ending 1916-17 was 300 acres only, whilst on the Shikarpur Canals it was 748 acres. *Juar*, *bajra* and rice are the most important *kharif* crops on the former canals and *juar* and rice on the latter and there appears no reason to believe that cotton will be in a better position to compete with these crops in the future than it has been in the past. In the Karachi Canals District, rice is practically the only crop grown and the tract owing to the flooding mentioned above is unsuitable for cotton.

100. The information submitted to us was not sufficient to enable us to express an opinion in regard to the financial aspect of the Sukkur Barrage Project and, in any case, this would be somewhat beyond our province. We would, therefore, in this connexion, merely draw attention to an interesting scheme for financing the project which was placed before us by the Hon'ble Mr. M. deP. Webb, C.I.E., C.B.E.

101.* We understand that, in the scheme for the Barrage and canals, provision is made for an intensity of fifty per cent., which means that one half of the culturable commanded area only will be irrigated annually. Although the evidence we received showed that this intensity is regarded as sufficient especially as it represents a considerable advance on present conditions under which the intensity is only $33\frac{1}{3}$ per cent., we consider that in constructing the canals, their possible enlargement to carry supplies sufficient for an intensity of at least 75 per cent. should be kept in view. Although such an enlargement may not be required for twenty or thirty years after their completion, it would undoubtedly prove cheaper in the end, if it were provided for at the outset. A canal, the intensity of irrigation on which is high, is cheaper both to construct and to maintain per acre irrigated than one on which the intensity is low. It is hardly necessary to point out that the higher the intensity of irrigation on the new canals, the greater the probability of the Barrage Project proving a financial success. Colonists for the land on the canals would be more readily forthcoming as the prospects would be more attractive

* Mr. Roberts and Mr. Henderson, whilst agreeing generally with the argument in this paragraph, consider that the canals dependent on the Sukkur Barrage should be designed for an intensity of 75 per cent. at the outset and that provision should be made for possible enlargement by fifty per cent. after fifteen or twenty years. Their reasons are that the success of the canals in Sind will depend mainly on *kharif* crops and that on the analogy of Egypt, an intensity of 200 per cent. may be regarded as desirable, especially if the cultivation of berseem fulfils the expectations which have been formed of it. If provision were made for an intensity of 75 per cent. at the outset, the intensity would probably rise automatically, as the result of improvements, to nearly 100 per cent. in ten or fifteen years. A sound system of agriculture cannot be evolved unless a fair proportion of leguminous crops is grown and experience in the Punjab has shown that this is not possible if the intensity is below 100 per cent. Mr. Henderson, who has great experience of Sind, considers 200 per cent. the optimum intensity for the Province.

The land under the canals could be kept much cleaner as the cultivator makes no attempt to keep his land clean when the proportion of fallow is high. There is the further consideration that the soil in Sind is rich and can stand heavy cropping, provided restorative crops can be grown. If, however, the ultimate intensity is below one hundred per cent., the cultivator will not be able to afford to put much land under such crops as berseem (Egyptian clover) which forms an excellent rotation with cotton. In this connexion, we would mention that although the Lower Chenab Canal, which is easily the most productive canal in India, was designed originally to irrigate 56 per cent. only of the culturable commanded area, it is now irrigating practically the whole of it. Whilst this is partly due to economy in the use of water, the canal itself can now actually carry over 10,000 cusecs instead of the 8,000 cusecs for which it was originally designed. We would also point out that on the Government farms in Sind, especially those at Mirpurkhas and Sukkur, the intensity of irrigation is nearly 200 per cent. The work of the Agricultural Department on the farms has shown that the view, which was formerly held, that except in the case of rice, the land in Sind was too poor to grow more than one crop in three years was entirely fallacious. It has, we consider, sufficiently demonstrated that a higher intensity of irrigation in Sind is both possible and desirable and that the construction of modern irrigation works is therefore justified, as far as this point is concerned. The work of the Department has, however, been based on the view that existing conditions would be entirely swept away with the introduction of perennial irrigation. We consider, on the other hand that the working out of the most suitable intensity of irrigation in existing conditions is perhaps the most important problem which confronts the Agricultural Department in Sind and are emphatically of opinion that work intended to benefit the cultivators on the Jamrao Canal and elsewhere should now be carried out, as far as possible, in conditions identical with those obtaining on their lands. For working out problems that will arise with the introduction of perennial conditions, we have suggested, in paragraph 108 below, the establishment of three agricultural stations with pumping installations.

102. There is no separate water rate in Sind. The charge for water

Water rates.

is consolidated with the land revenue assessment and varies according to the crop grown. The consolidated rate is very low and though, in the present unsatisfactory state of the water supply, it may not be desirable to raise it we are of opinion that, if a perennial supply were assured, there would be every justification for a considerable increase in the rates, which might eventually be brought up to the level of those in force in the Punjab. The soil is superior to that of the Punjab and Sind has the advantage over that Province of proximity to the port of Karachi, which is also the main outlet for the exports from the Punjab. It is obvious that increased rates would greatly improve the financial position of the Barrage Project. In connexion with the question of water rates, we would point out that, although rice takes three times as much water as cotton, the rate charged for both crops is, in most cases, exactly the

same. The evidence submitted to us showed that opinion is unanimous that the rate charge for rice is too low and should be raised. We do not feel called upon to express an opinion on the advisability of this course in present conditions as it does not appear probable that it would have any appreciable effect on the cultivation of cotton which is the only aspect of the case with which we are concerned. Should, however, a perennial supply of water be secured we are of opinion that, in order to ensure the economical use of water and to prevent waterlogging as far as possible, the rate for rice in tracts in which it is already grown should be raised to correspond more nearly to the quantity of water used but that no restriction, beyond what is involved in this, should be placed on the cultivators in regard to the crops grown by them. In tracts commanded by the perennial canals in which rice is not at present grown, it would, in our opinion, be wise to prohibit its cultivation entirely, a course which has worked well on the Jamrao Canal and has undoubtedly prevented the land under that canal from becoming waterlogged. It has also prevented the unprofitable and wasteful use of water.

103. We have little doubt that the very important question of the prevention of waterlogging will receive due consideration, should the Sukkur Barrage and the canals dependent on it be constructed.

Waterlogging and lining of canals. We were informed that there is no waterlogged land at present in Sind, except in the Karachi Canals District and in the south of the Fuleli Canal tract, both of which are rice areas. It would, however, appear that, since the opening of the Jamrao Canal, the subsoil water table at Mirpurkhas has risen considerably though it has remained more or less stationary for some years past. The change from a series of small inundation canals, which are only in flow for a few months in the year, to large perennial canals is a very drastic one and must result in a considerable alteration in subsoil water conditions. In view of the great importance of this question, we would recommend that a careful survey of the subsoil water table should be carried out either previous to or concurrently with the construction of the barrage. It is hardly necessary to point out that the waterproof lining of canals which has the double effect of economising water and of preventing waterlogging can be done very much more cheaply and efficiently when the canals are being constructed than after waterlogging has manifested itself when lengthy closures of the canals in order to carry out the necessary work cannot be obtained on account of the large areas of crops dependent on the regularity of the supply.

Another important question which will come into prominence when perennial irrigation is introduced into Sind, but in regard to which it is not now necessary to make specific recommendations is that of the prevention of *kalar* (alkaline salts). In a report on the subject in 1906, the Commissioner in Sind stated that "the occurrence of saline areas, in every gradation from isolated barren patches to continuous barren tracts many miles in extent is one of the most familiar factors in Sind, and the gravity

of the evil is to be measured not only by the diminution in the cultivated area and the injury to crops occasioned in localities where attempts are being made to control it, but also by the permanent exclusion from cultivation of large areas of otherwise valuable lands." That such land can be reclaimed has been successfully proved by the work at the Doulatpur Reclamation Station. The economics of *kalar* reclamation are, however, largely a matter of water supply. If this is precarious, the cost of reclamation is excessive.

104. A point which cannot be overlooked in discussing any scheme for providing Sind with an assured water supply is the prevalence of malaria in the Province, especially in the tracts served by the purely inundation canals. Experience in the past has shown that the construction of new irrigation works not infrequently increases the intensity of malaria in the tracts they command. The aggregation of labour forces on such works, without sufficient precautions to safeguard their health, has often been accompanied by outbreaks of malaria which have not only seriously impeded the progress of construction but have contributed to the unhealthiness of the commanded areas for considerable periods of time. In short, such schemes as the one under consideration have a public health aspect which it is important should be borne in mind. In view, therefore, of the bearing of this question on the supply of labour, difficulties in regard to which may well prove a serious obstacle to the development of Sind, we are of opinion that it should receive special attention when the Sukkur Barrage Project is taken in hand, as it seems probable that much could be done to minimise the risks of disease.

105. Our recommendations in regard to the work which should be done on cotton by the Agricultural Department in Sind in the future are based throughout on the assumption that the Sukkur Barrage and its connected canals will materialize. If they do not, there is, as we have stated more than once in the course of this chapter, no hope that long staple cotton can be successfully cultivated in Sind. In paragraph 91 above, we have already recorded our view that should it eventually be definitely decided to abandon the Project, all work on exotic cottons should be abandoned at the same time. Until a decision is reached, we do not recommend any propaganda in favour of American cotton. Work on this variety should, however, continue on the lines indicated below and the Agricultural Department should be in a position to supply seed to any cultivators who wish to grow it. Whilst we do not recommend any active measures to promote the cultivation of American cotton, we do not consider it desirable that it should be discouraged. Should interest in this variety be maintained even to a small extent, the work of the Department in spreading it will be rendered easier, once a perennial water supply is assured. We are, therefore, of opinion that the Department should render all assistance possible, in conjunction with the Central Cotton Committee, the formation of which we

have proposed in Chapter XIX below, in marketing any American cotton produced.

106. Whilst we are of opinion that the main botanical work should

Botanical work.

be on American cotton, we consider that, whether the Sukkur Barrage materialises or not, selection work on *deshi* cottons with a view to the evolution of superior types with longer staple and higher ginning percentage should be carried out on the lines we have already laid down for other provinces. We would here mention that efforts were made some years ago to raise the ginning percentage of *deshi* cotton by distributing from Mirpurkhas the seed of the cotton grown at Bhitshah which has a good reputation and a high ginning percentage. Although the seed given out was not that of a pure variety, the evidence we received showed that a considerable improvement was effected as a result of this work. In regard to American cotton, we would recommend that special attention should be devoted to selection work on the Triumph variety as this appears most likely to prove suitable to conditions in Sind. As we have already stated, the evidence submitted to us shows that imported varieties only succeed in India after acclimitization and, in these circumstances, selection work on Triumph is more likely to improve fruitful in results than the importation of fresh seed of that or any other variety. A comparison between the results obtained from Triumph and *deshi* cotton drawn up by the Deputy Director of Agriculture in 1916 on the basis of the farm records at Mirpurkhas is of interest. According to this, the average yield of the Triumph variety for three seasons was 739 pounds of *kapas* against 935 pounds for the local variety, whilst the ginning percentage was 31.1 against 33.5. There was thus a balance of outturn in favour of the local variety of at least 25 per cent., but it was pointed out that, except in 1914-15, when the cotton market was disorganised owing to the war, the premium for American cotton had fallen far below 25 per cent. Whilst this comparison is of interest, it cannot be regarded as in any way final. In the first place, the comparison was between *deshi* cotton and an imported variety, on which no selection work had been done with a view to the elimination of unsuitable types and to obtaining a higher ginning percentage. In the second place, the land on which the cotton was grown was uneven and scarcely suitable for tests of this nature. Lastly, the fact that the full premium was not obtained for the American cotton was due to lack of organisation and had no real relation to the intrinsic merits of the cotton. Experience, especially in the Punjab where conditions, except in regard to water supply, are similar to those in Sind but are not so favourable to the cultivation of American cotton, shows that if a suitable type is evolved, American cotton yields more heavily than *deshi* varieties under irrigation. Any comparison between the two should be based on trustworthy valuations and not on the prices actually obtained in present conditions. As we have explained elsewhere, the price warranted by the intrinsic value of a particular variety of cotton is difficult to obtain when it is not produced in commercial quantities. Whilst we consider that American cotton of the Triumph variety offers

the most hopeful prospects of success in Sind, we are of opinion that a new series of experiments on the lines we have suggested for American cotton should be started with Egyptian cotton, preferably with the *Mitaffiffi* variety.

107. From what has been stated in paragraph 88 above, it will be seen that there is a very wide scope for the improvement of cultivation in Sind. The inefficiency of the present methods of cultivation is, we are convinced, mainly due to the absence of an assured supply of water and its consequence, the fallow system. No great improvement can be expected until Sind obtains a perennial water supply. That once secured, a rapid advance may confidently be expected. The introduction of improved implements, suitable rotations, sowing in lines and interculture will then be possible. In regard to rotations, we would mention that we were much impressed by the success which has been obtained with berseem on the Government farms. The crops raised were as good if not better than those grown in similar conditions in Egypt. The work on the farms has shown that this crop forms the most suitable rotation with cotton in Sind. The question, whether it can be successfully grown in that Province has, therefore, an important bearing on the future of long staple cotton. We do not, however, foresee any great extension of the cultivation of berseem unless seed can be produced in paying quantities in India and a more intensive system of cultivation is followed. Berseem requires more water than wheat and, so long as there is plenty of fallow land available, the cultivator will prefer to grow a crop such as wheat in the *rabi* season as he can sell it more easily. It is only when the intensity is as high as one hundred per cent. that a *rabi* fodder crop will be extensively grown. In such conditions, a *rabi* fodder crop such as berseem can be sown with cotton in October whereas wheat requires preliminary cultivation and should, if possible, be grown after a fallow. The extensive cultivation of berseem like that of long staple cotton will, therefore, only be possible with a perennial water supply.

108. In order that the Agricultural Department should be in a position to deal with the new conditions which will ensue on the completion of the Sukkur Barrage and the canals taking off from it, we are of opinion that three agricultural stations with pumping installations should be established as soon as possible. One of these might be on the Nara Supply Channel, one near Sakrand, about half way down the proposed Rohri-Hyderabad Canal, and the third on the Fuleli Canal in the south of the tract which will be commanded by the Rohri-Hyderabad Canal. The area of each station should be at least 200 acres. As a perennial supply of water will be available by pumping, it will be possible to work out on these stations, on a small scale, the agricultural problems that will arise after the construction of the Sukkur Barrage. The intensity eventually decided upon for the Rohri-Hyderabad, Jamrao and Eastern Nara Canals should be strictly adhered to

on the greater part of the area but, at the same time, work on the optimum intensity of 200 per cent. should be carried out on the remainder. Particular attention should be paid to improved methods of cultivation of cotton more especially to that of sowing in lines. Careful comparative tests with American, Egyptian and *deshi* cotton should be carried out under perennial conditions and efforts should be made to discover the most suitable rotation with cotton in Sind in such conditions. It should be the object of these stations to obtain practical results which will enable the Agricultural Department to give the cultivators on the perennial canals trustworthy advice from the outset and to ensure that the development under those canals should proceed on thoroughly sound lines from the commencement.

109. It is obviously impossible for us, at this stage, to make any recommendations in regard to the establishment of seed farms and the distribution of the seed of long staple cotton in Sind where, it should be mentioned, the co-operative movement has made little progress. We would only emphasise the necessity for the retention by the Agricultural Department of control over the distribution of the seed of any variety of long staple cotton which it is eventually decided to give out. We would point out that, by the time the Department is in a position to take action in this respect, it will have the advantage of the experience gained in other provinces and should therefore have little difficulty in deciding upon the policy which is most suitable for adoption in Sind. We would, however, suggest in this connexion that the question of making large capitalist grants of land under the perennial canals, from two to five thousand acres in extent, should be considered. If it is found that the land system of the Province renders such grants possible, they would be of great use in many ways. Their existence would greatly facilitate the development of the tract. The large scale production, which they would mean, would assist the surrounding cultivators in marketing their produce and should go far to solve the difficult problem of securing a proper price for it. They could be utilised, to a large extent, as seed farms as they have been in the Punjab where, as already stated, grants have in some cases been made on condition that the grantees should utilise a proportion of their land for growing pure seed required by the Agricultural Department. We would suggest that some of these grants might be made on condition that the land is cultivated by steam ploughs as this would also help to bring about the more speedy development of the tract by reducing the amount of labour required. With direct cultivation by steam power, as compared with cultivation on the half share system, a landholder can afford to spend on cultivation and maintenance up to half the gross value of the crops produced, before he is in a worse position than a landholder farming on the half share system.

110. At present, Sind has one Deputy Director of Agriculture only whose headquarters are at Mirpurkhas. Communication with Bombay is difficult and the Director of Agriculture has his hands so full

Recommendations in regard to staff.

in the Presidency proper that his visits to Sind are very infrequent. The conditions in Sind are entirely different from those in the rest of the Presidency and the problems which will confront the Agricultural Department, if the Sukkur Barrage becomes an accomplished fact, are so important and complicated that we consider it desirable that the Agricultural Department in Sind should have a separate Director of Agriculture, whose headquarters should be at Karachi. For the present, we are of opinion that it will be sufficient if the Province is given two Deputy Directors, one for Upper and one for Lower Sind. The headquarters of the Deputy Director for Lower Sind should be fixed at Karachi. Mirpurkhas is not only unhealthy but is not on the main line of railway through the Province and is therefore difficult of access. We understand that it was originally selected as the headquarters of the Deputy Director as a temporary arrangement which has, however, since become permanent. The main work of the Deputy Director for Upper Sind should be that on the pumping stations, the establishment of which we have proposed above and his headquarters might conveniently be Sukkur. It follows from the recommendations we have made in paragraph 106 that we regard the appointment of an Economic Botanist for Sind as essential. The most important work of such an officer, who should possess special qualifications in research, should be on American and Egyptian cotton on the lines we have laid down, but he should also devote attention to the improvement of *deshi* cotton. In view of the fact that very little botanical work of any kind has hitherto been done on the crops grown in Sind, we would not confine him entirely to cotton, though other crops should occupy a secondary position.

As conditions in Sind much more closely resemble those of the Punjab than of the rest of the Bombay Presidency, we consider it desirable that the reorganised Agricultural Department should work in close touch with the Punjab Department. We are of opinion that Sind should eventually have an agricultural college of its own, either at Karachi or Hyderabad but that, meanwhile, the subordinate staff required should be trained at the Lyallpur Agricultural College rather than at Poona. Training at the latter college is, in our view, of little benefit to men who have to work in the conditions which prevail in Sind.

111. Our recommendations and conclusions in this chapter may be summarized as follows :—
Summary.

In regard to cotton under irrigation :—

- (1) The main reason for the failure of past efforts to grow Egyptian and American cotton in Sind has been the unsatisfactory character of the water supply.
- (2) There are no prospects of the successful cultivation of long-staple cotton in Sind, unless the Sukkur Barrage Project is carried out.

- (3) If the Sukkur Barrage and the connected canals are constructed, an area of 400,000 acres of long staple cotton under the Rohri-Hyderabad, the Jamrao and the Eastern Nara Canals may be confidently anticipated.
- (4) In present conditions of supply, no area of long staple cotton can be looked for on any of the canals not affected by the Sukkur Barrage Project.
- (5) In constructing the canals taking off from the Sukkur Barrage, their possible enlargement to permit of an intensity of irrigation of at least 75 per cent. should be kept in view.
- (6) If the Sukkur Barrage Project is carried out, the water rates in Sind might eventually be brought up to the Punjab level, the rate for rice, in any case, being raised to correspond more nearly to the amount of water used.
- (7) The cultivation of rice should be entirely prohibited in tracts under the perennial canals in Sind in which it is not already grown, but, beyond the raising of the rate for rice, there should be no other restriction in areas in which it is at present cultivated.
- (8) A careful survey of the subsoil water table should be carried out, either prior to or concurrently with the construction of the Sukkur Barrage.
- (9) The question of the prevention of malaria should be investigated, if the Barrage Project is undertaken.

In regard to the colonization of the area affected by the Sukkur Barrage Project :—

- (10) The question whether the land system of the Province is such as to render large areas of waste land on the new canals available for colonization should be thoroughly investigated by a strong Committee.
- (11) If this proves to be the case, the desirability of making capitalist grants on the new canals should be considered, such grants to be from two to five thousand acres in extent and to be made on conditions which would promote the speedy development of the tract and also render large supplies of pure seed available.

In regard to the work of the Agricultural Department :—

- (12) If it is eventually decided to abandon the Sukkur Barrage Project, all work on exotic cottons in Sind should be given up at the same time.
- (13) Meanwhile no active propaganda in favour of American cotton should be carried on but the Agricultural Department should continue to be in a position to supply seed to any cultivators who desire it and should assist in the marketing of their produce.

- (14) The main botanical work of the Agricultural Department should be on American and Egyptian cotton and should be directed to the evolution of better strains of the Triumph and *Mitaffiffi* varieties.
- (15) Further efforts should also be made to evolve varieties of *deshi* cotton of long staple and higher ginning percentage than those at present grown.
- (16) Three pumping stations should be established on which the problems which will arise on the completion of the Sukkur Barrage and the connected canals should be worked out. Amongst such problems would be improvements in cultivation, suitable rotations, the cultivation of berseem and the like.

regard to agricultural staff :—

- (17) The Agricultural Department in Sind should be separated from that of Bombay and should have its own Director of Agriculture with headquarters at Karachi.
- (18) The Province should be divided into two circles. An additional Deputy Director should be appointed for Upper Sind, with headquarters at Sukkur, whose main work would be the charge of the pumping stations, the establishment of which is suggested.
- (19) An Economic Botanist should be appointed to the Province whose main work should be on cotton, especially the American and Egyptian varieties.
- (20) Until such time as Sind has an Agricultural College of its own, the subordinate staff of the Agricultural Department should be trained at the Lyallpur Agricultural College rather than at the Poona College.

CHAPTER VII.

Bombay.

112. According to the figures for 1915-16, the area of the Bombay

Statistical.

Presidency proper, exclusive both of Sind, which has been dealt with in the preceding chapter, and of Native States, is 48,642,709 acres. The net area actually cropped during the five years ending 1916-17 averaged 26,161,000 acres, of which 3,962,000 acres were under cotton. The percentage of the area under cotton to the total area cropped was 15·1, a percentage which is only exceeded in Baroda and the Central Provinces and Berar. The percentage of the area under cotton to the total area under that crop throughout India averaged 17·7 for the five years ending 1916-17. In addition, the Native States in the Presidency returned an average area of 2,191,000 acres under cotton for the same quinquennium, a percentage of 9·8 of the total area under cotton in India. These figures are exclusive of those for the Baroda State which is in direct political relations with the Government of India and which we have consequently dealt with separately. We would mention, however, that Baroda territory is so intermingled with British districts that it is impossible to treat it entirely as a distinct unit for our present purpose. References to conditions in Baroda will, therefore, be found throughout this chapter. It will be evident from the figures given above, that Bombay and Baroda form together the most important cotton growing tract in India. It is not surprising, in these circumstances, that the cotton problems are more complex and difficult than they are elsewhere.

113. The cotton growing tracts of the Bombay Presidency fall into

Climate and soil.

four main divisions between which, however, there is no well defined boundary. The tract which produces the cotton which passes by the trade name of "Dholeras" comprises the greater part of North Gujarat, *i.e.*, the Ahmedabad and part of the Kaira and Panch Mahals Districts, the adjoining parts of the Baroda State and the greater part of Kathiawar. Immediately south of it is the tract which produces the cotton known by the trade as "Broach." This tract, which, as a whole, forms Southern Gujarat, includes the Broach and Surat districts in British territory and the adjacent parts of the Baroda State, more especially the district of Navsari. Outlying parts of it are also to be found in Kathiawar. The third main division, which produces the cotton known as "Khandesh," originally included only the two districts of East and West Khandesh but now comprises the Nasik, Ahmednagar and Sholapur districts and the northern part of the Bijapur district. All these districts, with the

exception of Bijapur, form part of the Bombay Deccan. The fourth main division is that which produces the cotton the trade name of which is "Kumpta-Dharwar." It includes the districts of Dharwar, Belgaum and the greater part of Bijapur as well as several Native States, of which Kolhapur and Sangli are the most important, and thus comprises practically the whole of that part of Bombay which is known as the Karnatak. The climate of the cotton growing tracts differs very considerably. Gujarat has an ample rainfall of thirty to forty inches, which increases from north to south and by far the greater part of which is received from the south west monsoon. It has a pleasant cold season but the heat is oppressive during the summer months. The temperature falls on the burst of the monsoon but the air remains hot and sultry till October. The climate of the Deccan districts resembles that of Berar, being very hot in March, April and May and fairly temperate for the rest of the year. The rainfall varies from twenty to thirty inches. The bulk of it is received from the south west monsoon but there are heavy storms from the north east in October. The Karnatak districts, with the exception of Bijapur, where climatic conditions differ little from those of the Deccan, have a heavier rainfall than the latter, especially in its western portion, the average at Belgaum being 52.30 inches. They receive more rain from the north east monsoon than any of the other cotton growing tracts and the extremes of temperature are not so marked.

The soils of the Presidency vary with its natural divisions. In Gujarat they are classed in two main divisions, *kali* and *goradu*. The first is the black cotton soil of which extensive tracts are found in Broach and Surat. It is supposed to be result of an alluvium brought down by the Tapti and Narbada rivers and corresponds to the black cotton soil of the Central Provinces and Berar. *Goradu* soils are characterized by immense depth, varying from the drift sands of Ahmedabad to the rich loam of Kaira. They are entirely alluvial. The soil of the cotton tracts of the Deccan and the Karnatak is also mainly black cotton soil formed, in this instance, by the weathering of the trap rock. It varies greatly both in texture and in depth.

114. The cotton crop of the Bombay Presidency presents more botanical problems than any other part of India. The cotton known as "Dholleras" is especially diverse in its botanical characteristics. It is generally accepted that, previous to the famine years of 1899-1900, the prevailing type was a variety of *G. herbaceum*, known as *lalia*, with a staple of $\frac{5}{8}$ ths to $\frac{6}{8}$ ths inch and a ginning percentage of 33. *Lalia* has now, to a very large extent, been replaced by a mixture of various varieties. In the neighbourhood of Viramgam in the Ahmedabad district and in parts of Kathiawar and Cutch, the variety known as *wagad*, which is also *G. herbaceum*, is grown almost pure. It is peculiar in that the bolls do not open even when the cotton is ripe. The cotton is, therefore, picked in the bolls and is extracted subsequently. It is the best cotton in the mixture, its staple being $\frac{6}{8}$ ths inch to $\frac{7}{8}$ ths inch

and its ginning percentage 33. In the Kaira and Panch Mahals district and in the Daskroi *taluka* of Ahmedabad, the varieties known as *kanvi* and *goghari* are found. *Kanvi*, the staple of which is from $\frac{4}{8}$ ths to $\frac{5}{8}$ ths inch and the ginning percentage 35, is, in reality, only a mixture of Broach and *goghari* cotton. *Goghari* is an inferior variety of *G. herbaceum*, the origin of which is obscure. It has a weak staple of $\frac{4}{8}$ ths to $\frac{5}{8}$ ths inch in length and a ginning percentage of 40. Over large tracts of Ahmedabad and Kathiawar, the prevailing type of cotton is that known by the trade as *matkio*, a mixture the constituents of which are the same as those of the Khandesh mixture with the addition of the variety known as *G. neglectum kathiawarensense*. Of the varieties of *neglectum*, three, *G. N. cutchicum*, *G. N. kathiawarensense* and *G. N. roseum*, predominate. The first two were introduced from Berar and Khandesh in 1899-1900 to replace *lalio* which was almost exterminated by the drought of those years. The third, *G. N. roseum*, is a more recent importation. The staple of the constituents of the mixture are the same as in Khandesh and its ginning percentage is 32. *Rozi* or *jaria*, a variety of *G. obtusifolium* and a perennial cotton, is found in the Kaira district. Its staple is $\frac{4}{8}$ ths to $\frac{5}{8}$ ths inch in length and its ginning percentage 35. In addition to these varieties, mention should be made of Bourbon cotton (*G. purpurascens*) which represents the only survival of the attempts, which are described below, to introduce exotic cottons into this tract and is still found in hedges in the Ahmedabad and Kaira, districts. In recent years, several cultivators in those two districts in which cotton is often grown under well irrigation, have grown Cambodia (*G. hirsutum*). At the outset, it met with some success but it was eventually abandoned almost everywhere in favour of *lalio* which was considered more certain and profitable, especially as great difficulty was experienced in disposing of the small quantities of Cambodia produced.

The following table shows the percentage composition of the mixture grown in the "Dholleras" tract. It will be seen that, in many cases, even when the cotton passes under the specific name of *lalio*, *wagad*, etc., it contains a proportion of other varieties.

Name.	Locality.	White Flowered Neglectum.	Yellow Flowered Neglectum.	G. Hirsutum (Upland Georgian and Cambodia).	G. HERBACEUM.					G. Obtusifolium Rozi.
					Broach.	Goghari.	Kanvi.	Lalio.	Wagad.	
AHMEDABAD DISTRICT.										
Lalio	Dholera.	..	..	..	..	..	89.3	107	..
Wagad . . . . .	"	..	..	..	..	..	100	90.0	..
Lalio	Sauand.	..	..	..	..	..	97.3	2.7	..
Wagad . . . . .	"	..	..	..	..	..	13.6	87.3	..
Deshi	Viramgam.	..	..	..	..	59.3	..	100.0	..
Lalio . . . . .	"	..	..	..	..	..	41.7	..	..
KAIRA DISTRICT.										
Rozi	Anand.	..	..	..	..	14.2	60.8	..	100
Kanvi	Thasra.	..	..	..	..	45.2	3.7	..	25
Rozi . . . . .	"	..	..	..	..	..	54.8	..	96.3
Kanvi	Mehmadabad.	..	..	..	..	..	..	..	..
Malvi	"	58.4	22.2	19.4	..	47.8	..	..	..
Kanvi . . . . .	"	..	..	..	..	..	52.2	..	..
Jadana	Matar.	..	..	..	..	..	..	..	..
Nadiad	"	42.3	53.9	3.8	..	..	..	..	..
Deshi . . . . .	"	..	..	4.5	..	..	..	..	95.5
Rozi	Borsad.	..	..	..	..	..	16.7	..	83.3
American . . . . .	"	..	..	100	..	..	..	..	..
PANCH MAHALS.										
Deshi	Godhra.	4.0	96.0	..	..	51.4	48.6	..	..
Kanvi	Kalol.	70.4	18.5	..	11.1	..	..	..	..
Khandesh . . . . .	"	..	..	..	..	..	..	..	..

115. Whatever may have been the position formerly, it is now impossible to treat the tract which produces
(ii) **Broach tract.** "Broach" cotton as a whole botanically and

is must be sub-divided into three tracts. The first of these comprises the Broach district north of the Narbada and the adjacent parts of Baroda with some outlying areas in Kathiawar. The second tract includes the southern part of the Broach district as well as the Surat district. No definite boundary can be laid down between this and the third tract, of which the centre is Navsari. The cotton of the whole Broach tract reaches its maximum excellence at Bilimora in the Navsari district. It should be clearly understood that, throughout the three sub-divisions mentioned above, except for the small amount of Bourbon cotton (*G. purpurascens*) which is grown for domestic purposes, only one species of cotton is found, viz., *G. herbaceum*. No tangible distinctions are to be found in the plants themselves, and the differences in the lint and, to a less extent, in the ginning percentage do not manifest themselves until after the crop is ripe. The position in the Broach tract, taken as a whole, is that the cotton increases steadily in value from the north downwards. All the evidence we have received goes to show that, until recent years, the cotton of the first of the three tracts which, for convenience, may be called the Broach *deshi* tract, was the same excellent type of *G. herbaceum* as that grown in the Surat and Navsari tracts. Unfortunately there existed in this tract, more especially in the Amod and Jambusar *talukas*, the inferior variety of *G. herbaceum*, known as *goghari*, to which reference has been made in the preceding paragraph. The high ginning percentage of this variety brought it into such favour with the cultivators that its extension throughout the Broach *deshi* tract has proceeded with extreme rapidity and it has been the main cause of the fall in the reputation of all Broach cotton in recent years. There is good reason to believe that it will continue to spread both in the Broach *deshi* tract and in the Surat and Navsari tracts unless immediate steps are taken to check its extension. In regard to the two latter tracts, it would appear that the superiority of the cotton grown in the Navsari tract to that grown in the Surat tract is due to the more genial climate, resulting from its closer proximity to the sea, and to the slightly higher proportion of clay in the soil. The staple of the cotton grown in the Broach *deshi* tract is $\frac{5}{8}$ ths inch to $\frac{3}{4}$ ths inch and its ginning percentage 32, except where it is grown with *goghari* and becomes the mixture known as *kanvi*. Its staple then falls between $\frac{4}{8}$ ths and $\frac{5}{8}$ ths inch but its ginning percentage increases to 35. The staple of the cotton grown in the Surat tract is $\frac{7}{8}$ ths inch and its ginning percentage is 32. The corresponding figures for the Navsari tract are one inch and 31.

An analysis of the cotton grown in the Broach *deshi* tract has shown that the composition of the cotton is as given in the following table : —

Name.	Locality.	Broach variety.	Goghari variety.
Deshi	Ankleswar .	63.6	36.6
Deshi	Hansot . .	93.1	6.9
Goghari	Rajpipla .	89.7	10.3
Goghari	Jambusar .	7.9	92.1
Goghari	Broach . .	20.7	79.3
Deshi	Broach . .	52.4	47.4

An analysis of the cotton grown in the Surat and Navsari tracts has shown that it consists throughout of the pure Broach variety, except in the Choreshi *taluka* where the cotton contains 8.3 per cent, of *goghari* and in the Olpad *taluka*, where the percentage of *goghari* is 2.5.

116. The cotton known by the trade as "Khandesh" which, as already stated, is grown in East and West
 (iii) **Khandesh tract.** Khandesh, Ahmednagar, Nasik, Sholapur and part of Bijapur, consists of a mixture of the same varieties of *Gossypium neglectum* as are found in the Central Provinces and Berar. There are *G. N. malvense*, *G. N. verum*, *G. N. cutchicum* and *G. N. roseum*. The mixture includes, as in the Central Provinces and Berar, a small proportion of the Upland Georgian variety (*G. hirsutum*), a survival of past efforts to introduce exotic cottons into Khandesh. *Bani* (*G. indicum*) is, however, entirely absent. The staple of the Khandesh mixture is slightly shorter than that grown in Berar, being on an average $\frac{4}{8}$ ths inch to $\frac{5}{8}$ ths inch. Its ginning percentage is 32. *G. N. roseum* is now gradually replacing the mixture, though its progress has been much slower than in Berar. It is estimated that 30,000 acres are now under this variety in a pure state. The staple of *roseum* in Khandesh is from $\frac{3}{8}$ ths to $\frac{4}{8}$ ths inch and its ginning percentage is 38.

117. The most important variety of cotton grown in the "Kumpta-Dharwar" tract, which, as mentioned above,
 (iv) **Kumpta-Dharwar tract.** includes the districts of Dharwar and Belgaum, the greater part of Bijapur and the Native States of Kolhapur, Sangli, etc., is that known as *kumpta*, a variety of *G. herbaceum*, which is grown throughout the tract. It is at its best in Belgaum but is almost equally good in Dharwar, falling off in quality further eastwards. It differs from the variety of *G. herbaceum* grown in Gujarat in its shorter period of growth, smaller bolls and lower ginning percentage, the latter being only 26. The staple of the *kumpta* variety is $\frac{7}{8}$ ths inch in length. The cotton known as "Saw ginned Dharwar" or "Dharwar American" is a more or less intimate mixture of two acclimatized varieties, Upland Georgian (*G. hirsutum*) and New Orleans (*G. mexicanum*). It is mainly found in the Dharwar district where it is usually grown as a mixture with *kumpta*, sometimes intentionally but more often unintentionally.

The staple of Dharwar American is $\frac{5}{8}$ ths to $\frac{7}{8}$ ths inch and its ginning percentage 30. Of minor importance in this tract are Cambodia (*G. hirsutum*) which is now grown on about five thousand acres in the Gadag and Ron talukas of the Dharwar district and Dharwar Broach, introduced by the Agricultural Department some ten years ago. The latter is grown on about five thousand acres in the west of the Dharwar district where the south west monsoon sets in sufficiently early to give it the long season necessary for its successful cultivation.

118. In North Gujarat and in Khandesh, cotton is sown in June.

Cultivation of cotton.

In South Gujarat, cotton is sown between June and September and cotton sown in September often does very well. In the north of the Broach tract, resowing in July and August is often necessary. Picking in Gujarat commences in January and continues until April and May. The growing season may thus be said to extend over 200 days but the climate is cool during the formation of the bolls which takes as much as sixty days. In Khandesh, which has a much shorter season, picking begins in October and is over in December. In the Karnatak, which receives more rain from the north east monsoon than any of the other cotton growing tracts, sowing does not commence till the latter part of August and extends into September. Picking takes place from March till May. The cultivation of cotton throughout the Bombay Presidency is very good, especially in the Broach tract, where it is perhaps more thorough and advanced than in any other part of India. In Gujarat and in the heavier soils in Khandesh, the land is seldom ploughed but is harrowed during the dry season after the harvest of the preceding crop. Ploughing is, however, the general practice in the lighter soils in Khandesh and throughout the Karnatak. In the latter tract, the land is sometimes dug over by hand, owing to the presence of deeply rooted weeds and grasses. Such weeds and grasses are specially common in North Gujarat and are found more or less throughout the Deccan as well as in large tracts in Khandesh. *Lavala* (*Cyperus rotundus*) is worst in Gujarat, whilst in the Deccan and the Karnatak, *hariali* (*Cynodon dactylon*) and *kunda* (*Ischaemum pilosum*) give most trouble and prove serious enemies to cotton. Experiments with gear and steam ploughs have been carried out by the Agricultural Department in the Karnatak and have met with a moderate measure of success. Cotton throughout the Presidency is sown in lines with drills and, in the Broach tract, it is the practice to thin it out subsequently. On deep retentive soils in that tract, which have a good rainfall, rice is sometimes grown with cotton either in the same row or in alternate rows. It is, however, the subordinate crop. Coriander and other condiments, and occasionally *sesamum* or gram, are also often grown with cotton, especially when there are found to be gaps in the latter crop. In Kaira, the perennial *rozi* cotton is invariably grown in rows with *bajra* (*Pennisetum typhoides*). Interculture is most efficient in the Broach tract but is also very well done in Khandesh. In the former tract, the Agricultural Department has had some success in introducing planting in squares, which enables interculture to be done in both directions. An obstacle

to the progress of this method is presented by the fact that it takes more time than the ordinary method but it is estimated that about ten thousand acres are now sown in this way. The most usual rotation throughout the Presidency is cotton and *juar* (*Sorghum vulgare*). In the Dholleras tract, *bajra* (*Pennisetum typhoideum*) takes the place of *juar* on light soils and wheat is occasionally substituted for it on heavy soils. In the Broach tract, *lang* (*Lathyrus sativus*) wheat or *tur* (*Cajanus indicus*) often take the place of *juar*. Cotton, however, often follows cotton, especially in the Surat and Navsari districts. Fallowing is much resorted to in these tracts and cotton is often sown in rows from six to twelve feet apart, the intervening space being left unoccupied and thoroughly cultivated, to be sown with cotton in the following year. Efforts have been made by the Agricultural Department to introduce leguminous crops, especially ground-nut, into the rotation and also to secure the cultivation of *sann* hemp with cotton as a green manure. Both these methods have been taken up on a fairly large scale in the Broach tract and, in Khandesh, the cultivation of ground-nut as a rotation with cotton is spreading rapidly. It should be mentioned that, although in the Dharwar American part of the Kumpta Dharwar tract, that variety is often sown with *Kumpta*, the latter ripens later so that both varieties are marketed fairly pure. Throughout the whole of the Bombay cotton tracts, cotton occupies an unusually high proportion of the cropped area, which means that a three year rotation is seldom found. Cotton is usually grown in alternate years and frequently in two successive years. The most usual manure is farm-yard manure, but, as elsewhere, the supply of this is limited and it is rarely applied more than once in three years. Artificial manures have not proved profitable in the case of cotton. Poudrette and crude night soil have given excellent results in Gujarat and Khandesh but their use as a manure has, until very recently, been no more popular in Bombay than in other parts of India. Cultivators are now, however, beginning to use them where proximity to a municipality renders them available.

119. The history of the efforts to grow exotic cottons in Bombay as well as to improve the indigenous varieties is very lengthy and only a brief, and necessarily imperfect, sketch of it can here be given. It commences, as does that of Madras, about 1790 when Dr. Anderson was employed to distribute seed from Malta and Mauritius throughout the Peninsula. The Bourbon cotton, which is still to be found in parts of the cotton tracts as well as in the Konkan, is a relic of his work. A fresh supply of seed was obtained from Mauritius in 1812, and was distributed to the Collectors of Broach and Surat. Experiments with this variety on a fairly large scale were carried out by an Assistant Surgeon named Gilders in Kaira in 1815 and the following years, but in spite of the offer of money prizes for its successful cultivation, proved a failure. About 1830, the first two experimental farms in India were opened, that at Broach being placed under the superintendence of Mr. Finney, whilst Dr. Lush was appointed to the charge of the experiments in the Deccan, including

History of efforts to introduce exotic cotton in Bombay.

Khandesh, and at Dharwar, where the second farm was located. Although the introduction of American cotton into Dharwar is often attributed to Dr. Lush, neither his work nor that of Mr. Finney left any real mark on cotton in Bombay. Of the twelve American planters who, as already mentioned in the chapter on the United Provinces, were brought out to India in 1840, three were allotted to Bombay, where they started work in Broach. They entertained so little hope of ultimate success and were so discontented with their prospects that they shortly afterwards resigned their appointments. In spite of this, it was decided to continue the experiments but although the services of planters from other provinces were secured, neither in Broach nor in Khandesh was any success obtained. Trials of exotics carried out about this time both by officials and non-officials all over Gujarat, the Deccan and the Konkan were no more fruitful in results. It was only in Dharwar that there has been any survival of the work of the twelve planters in India and, even there, the initiative came from Mr. A. N. Shaw, the Collector. New Orleans seed grown by him in the Hubli *taluka* in 1842 was favourably reported on by Mr. Mercer, one of the planters, who had been transferred to Bombay from the United Provinces and, partly as a result of his efforts, and partly owing to the fact that Government in the early years agreed to purchase the whole of the crop, its cultivation, in spite of some checks, made rapid progress, the area under it reaching 178,682 acres in 1861-62. About 1858, the reputation of the Dharwar-American variety fell, owing to adulteration and admixture with the indigenous cotton. The difference in price between Dharwar-American and *kumpla* which, in 1850-51, had been from 1*d.* to 1½*d.* per pound in favour of the former had, in 1859, dropped to a farthing. Steps were, however, taken to prevent the careless sowing of mixed American and indigenous cotton and to secure that the saw gins used for ginning the former were kept in proper order and this resulted in a marked improvement in the quality of the cotton.

A Cotton Commissioner was appointed for the Bombay Presidency in 1863, the first holder of the appointment being Dr. Forbes. Shortly afterwards, four superintendents of cotton experiments were also appointed who were posted to Dharwar, Gujarat, Khandesh and Sind respectively. Trials of Sea Island, Egyptian, Peruvian, and other exotics were carried out at Viramgam and Surat and in Khandesh and attempts were made to introduce Dharwar American, Hinganghat and Broach into parts of the Presidency in which they were not already grown but these fared no better than their predecessors. The efforts of Mr. Ashburner, Collector of Khandesh, in 1866, to stamp out the variety known as Nagpur *jari vilayati* or "Old Khandesh" which resulted in driving it into Berar have already been mentioned in the chapter on the Central Provinces. In 1873-74, it was decided that the experiments in introducing exotics into Khandesh should be abandoned but they were renewed in the case of Dharwar American about 1879-80. It should be mentioned that fresh seed was imported from America at intervals and distributed in the Dharwar district. In 1883-84, the

work of the Cotton Department was taken over by the Department of Land Records and Agriculture. This history of cotton improvement in Bombay for the next few years is almost entirely that of experiments with American and other varieties on the Bhadgaon farm in Khandesh. It is unnecessary to describe these at length and it is sufficient to say that when the farm was sold in 1892-93, Mr. Ozanne, then Director of Land Records and Agriculture, considered that it had been proved that long stapled varieties, though not successful when sown at once as received from America, would succeed well if acclimatized at Dharwar and that such cottons were useful on light land. Meanwhile in 1891-92, and subsequent years, American cotton had been tried at Nadiad in Gujarat, Dharwar American in the Nara Valley and Egyptian cotton in various places in Gujarat and elsewhere but with the usual lack of success. By 1897-98, Mr. Mollison, then Deputy Director of Agriculture, had come to the conclusion that exotic varieties of cotton were unsuited to the conditions of Indian agriculture, that an indigenous variety found suitable in one district might prove unsuitable to another and that the only hope of improvement lay in taking the varieties that were found in general cultivation and in trying to improve them by selection of seed carried on from year to year. From this time onwards, the attempts to introduce exotics into the Bombay Presidency may be said practically to have ceased, though experiments with American and Egyptian varieties continued to be carried out on the farms, more especially between 1905 and 1910. With the exception of unsuccessful attempts to introduce tree cottons into the Karnatak, the introduction of Cambodia on a small scale in the west of the Dharwar district and some work on Dharwar American in the same district, the energies of the Agricultural Department have been devoted to the improvement of the indigenous cottons and are described in detail below. Making every allowance for the advance of scientific knowledge since the early efforts to introduce exotics in Bombay, we see very little prospect for such cotton except in the Kumpta Dharwar tract and are, therefore, of opinion that the policy followed by the Agricultural Department has been the correct one.

120. Very little botanical work has so far been done by the Agricultural Department on the varieties which

Botanical work :—
(i) **Dholleras.**

make up the mixture known as "Dholleras." It should, however, be mentioned that experi-

ments in hybridization with exotic cottons have been carried out on the Nadiad farm near Ahmedabad but have led to no definite results as it has been found that none of the hybrids produced is suited to the climatic conditions of the tract.

121. The main botanical work on the cotton of the Broach tract has been carried out at Surat, where operations

(ii) **Broach tract.**

commenced in 1896, the object of which, as then stated, was to establish a variety of long and silky staple but of sufficient hardness to pay the cultivator to grow it. The crossing work carried out resulted, in 1905-06, in the evolution of a cross between

kumpta and *goghari* known as 1027 A, which was valued as high as twenty per cent. above the ordinary cotton of the tract. Two other crosses, 1338, a cross between Broach and Broach and 1319, a cross between *kumpta* and *kumpta*, also showed marked superiority over the local variety. In 1907-08, there was, however, a set-back to the work. It was found that there was considerable variation in the Surat crosses and that, whilst the relative advantage in quality which some of them possessed over the ordinary cotton was high, their ginning percentage was steadily falling. In spite of this, 1,500 pounds of hybrid seed were distributed in 1908-09, the growers obtaining a premium of Rs. 7 per *bhar* of 924 pounds over the ordinary variety. In 1910-11, the hybrids and selected strains on the Surat farm were narrowed down to three, "Selected Surat" and two crosses, known as 1018 PG and 1027 ALF, and three thousand acres were sown with these cottons. The following year, matters had progressed so far that a Syndicate was formed by certain members of the Bombay Millowners' Association, which undertook to buy the cotton grown from the seed at five per cent. above the market rate and to return the seed to the Agricultural Department for distribution. The scheme did not, however, prove a success and the operations of the Syndicate ceased in 1912-13. We have dealt with the causes of this unfortunate result in Chapter XVI. Since the break down of the arrangements with the Syndicate, other methods of disposing of the cotton grown from the seed supplied by the Agricultural Department have been adopted and are described in paragraph 130 below. They have not proved successful in promoting the extension of the cultivation of the improved strains, the maximum area under which, in recent years, has been only 1,200 acres. Although three improved strains, Selection IA, the cross known as 1027 ALF and Selection II, are still being grown on the farm, it has been decided to concentrate almost entirely on Selection IA and the seed given out last year was nearly all of this variety. The comparative value of the three strains just mentioned and of the local cotton have been worked out on the Surat farm as follows :—

Name.	Yield of seed cotton per acre in pounds.	Ginning percentage.	Valuation per <i>khandi</i> .
			Rs.
(1) IA	559	36.5	341
(2) 1027 ALF	519	35.4	346
(3) II	632	35.1	330
(4) Local cotton	503	33.2	332

It should be mentioned that an experimental station has recently been established near Broach, the main object of which has been to

ascertain definitely the actual characteristics of *goghari*. Four types of this variety were separated and tested but it was found that none of them possessed any good feature from the point of view of quality.

122. The botanical work in the Khandesh tract, since the re-organization of the Agricultural Department in

(iii) **Khandesh tract.**

1903-04, has proceeded on very much the same lines as in the Central Provinces and Berar. Work on the separation of the constituents of the local mixture was commenced in 1905, and it was found that, as in Berar, *G. neglectum roseum* was the most profitable both as regards yield and ginning percentage. In this tract, the Agricultural Department has, therefore, mainly devoted its energies to the spread of this variety and in 1916-17 seed sufficient for thirty thousand acres was distributed. The Sindewahi cross between *bani* and "*deshi Lahore*" introduced from the Central Provinces has been tried in this tract and has produced cotton of fair quality with a ginning percentage of about 36.

123. The main botanical work in the Kumpta Dharwar tract has

(iv) **Kumpta Dharwar tract.**

(a) **Kumpta and Dharwar Branch.**

been directed to the improvement of the *kumpta* variety and has been carried out on the Dharwar farm. It may be mentioned that *kumpta*, as is the case with other varieties of *herbaceum*, is possessed of very stable characteristics and that it is therefore difficult to produce anything in the nature of a recognizable improvement in it. Recent researches have, however, shown that the quantity of the crop can be sensibly increased by a change in the mode of growth. Such a change can be brought about by the selection of an early maturing type, the characteristics of which are an upright habit of growth with many fruiting branches and few vegetative branches. This character is freely inherited although it is sometimes masked by the check caused to the leading shoot by the borer which attacks its pith. The selections which are now being made all conform to this type, which furnishes a distinguishing mark capable of easy detection in the field, where plants of the bushy type are most prevalent. The more compact habit permits of closer planting and therefore results in a heavier crop. It should be added that the same type of plant is being tested in the case of the varieties of *herbaceum* grown in Gujarat, as any factor which tends to an increase in the outturn of cotton without adding to the area under it is obviously of great importance and worth careful study.

The work on the Dharwar farm, which for some years past has been confined to the *kumpta* variety and to Broach cotton introduced from Navsari and now known as Dharwar Broach, has resulted in the evolution of two excellent strains of *kumpta*, one of which, known as Dharwar Selection I, is a selection from *kumpta* and the other known as the *kumpta* cross is a cross between *kumpta* and *kumpta*. A cross between *kumpta* and *goghari* has also shown great promise. The comparative

merits of the various strains and of the local cotton are shown in the following table :—

Name.	Yield of seed cotton per acre in pounds.	Ginning percentage.	Value per <i>khandi</i> .
			Rs.
Selection I	583	28	341
<i>Kumpta</i> Cross	552	30	344
<i>Kumpta</i> x <i>goghari</i> (a)	598	32	325
Do. (b)	498	35	315
Local <i>kumpta</i>	527	25	310

Although the *kumpta* cross has reached a field scale and the Department, assisted by the local Agricultural Associations has distributed seed, for which there is an increasing demand, it is now proposed to give out the seed of Selection I instead. The objections to the *kumpta* cross are that it is later than either Selection I or the ordinary *kumpta*, is more subject to wilt and produces a certain number of barren plants. On the other hand, Selection I has all the agricultural characteristics of the ordinary *kumpta* to which the cultivator is accustomed. Careful control of seed distribution is therefore especially necessary in the case of this selection.

In regard to Dharwar Broach, tests carried on for fourteen years on the Dharwar farm have shown that, from the third year onwards, there is a steady fall in the ginning percentage which goes down to 28. Fresh importations of seed from Broach are therefore necessary. The period of growth of this variety is much longer than that of *kumpta* and the fact that the time at which it is sown coincides with that of *juar* also tells against it.

The work on American cotton which was, for many years after the reorganization of the Agricultural Department, carried out on the Dharwar farm was transferred entirely to Gadag in 1912. Numerous varieties of Upland American imported from the United States have been tested but, so far, without any definite results. Experience throughout India has shown that, wherever annual American cottons have been grown, the Upland Georgian type is more immune to the effects of climate and insect pests than the New Orleans type and steps are, therefore, being taken to eliminate the latter from the Dharwar American mixture. The comparative tests of the two varieties at Gadag have established that the ginning percentage of the Upland variety is 32 against a percentage of 28 for the ordinary mixture and that its value is Rs. 5 per *khandi* higher.

The superiority of Cambodia, more particularly in the matter of ginning percentage, which, on the Gadag farm, has been 38 against 28 for the Dharwar American mixture, appears to have resulted, to a somewhat undesirable extent, in the diversion of the attention of the Agricultural Department from Dharwar American to this variety. The results obtained in the first year after the introduction of Cambodia were satisfactory and the variety, consequently, spread with some rapidity until it was realized that it suffered severely from rain after germination, to which the Dharwar American mixture proved less sensitive. Through the usual want of care, many cultivators allowed it to become mixed in their fields with the result that their produce could not be certified as pure by the Agricultural Department. There has also been a marked deterioration in staple.

124. The botanical problems which confront the Agricultural Department in the Dholleras tract are, perhaps, even more intricate than they are elsewhere. The cotton trade has, in recent years, complained frequently and seriously in regard to

Recommendations in regard to botanical work :—

(i) **Dholleras.**

the indiscriminate mixture which passes under the name of "Dholleras" but it is not an easy matter to suggest a suitable remedy. The destruction of the *herbaceum* variety in Kathiawar accounts, in the greatest measure, for the recent alteration in the "Dholleras" type, another reason for which, is, however, the fact that the widely prevalent demand for cotton with a high ginning percentage has favoured the extension of the inferior *goghari* and *mathio* and the increasing importation of seed from Jambusar and Khandesh. We consider that the first essential in this tract is that exhaustive tests should be carried out in order to ascertain which of the constituents of the present mixture are most suitable to the different parts of the Dholleras tract. Thus, for example, *wagad* should be tested against other varieties near Viramgam and Sanand, *lalio* near Ahmedabad or Nadiad, *mathio* in either the Dhanduka or Gogha taluka of Ahmedabad, *goghari* near Jambusar and *kanvi* in the extreme south of the tract. It is obvious that, until work of this character has been carried out, the Agricultural Department will not be in a position to decide to which variety its attention should be devoted in the different localities. Some tests of this character have already been commenced but the staff of the Department, in regard to which we make recommendations below, has been insufficient to cope with the work and it is necessary that the problems should be attacked with increased energy in order that the relative values of the components of the "Dholleras" mixture may be definitely ascertained and that the Agricultural Department and the cotton trade may be in a position to decide what steps should be taken in regard to them. In the meantime, we are of opinion that efforts should be made by persuasion and encouragement and by the provision of facilities for obtaining pure seed to maintain the purity of *wagad* in the neighbourhood of Viramgam and to restore *lalio* to something like its former purity in the remainder of Ahmedabad district, in the Kaira District and in the adjoining parts of Baroda and Kathiawar. In regard to *wagad*, the problem

should be rendered easier by the action of the merchants and owners of ginning factories in Viramgam, the principal centre for this variety. In order to maintain the reputation of the cotton of the tract, these have combined together to refuse to gin any cotton other than *wagad* and have by so doing, set an example which we could wish were widely imitated but which is, at present, unique.

125. Throughout the whole of the Broach tract and more especially

(ii) **Broach tract.**

in what we have called, in paragraph 115 above, the Broach *deshi* tract, the problem which has to be solved by the Agricultural Department, is whether the position should remain in the unsatisfactory state in which it is at present or whether active steps should be taken to stop the advance of *goghari*. In our opinion, it cannot ultimately prove in the real interests of the cultivator that the quality of Broach cotton should be allowed to deteriorate still further, in view of the great trade reputation that variety has possessed till recent years and still possesses so far as the cotton coming from the Surat and Navsari tracts is concerned. The restoration of the staple of the whole of the Broach crop to the standard of ten years ago, would represent a great advance. It would be contrary to the whole tenor of our report to recommend that any measure savouring of compulsion should be taken to prevent the cultivator from growing *goghari*. But, as the additional profit given by this variety is estimated to be no more than Rs. 3 per acre, we consider that it should prove comparatively easy for the Agricultural Department to evolve a type of Broach cotton which, whilst as superior to *goghari* in the matter of staple as is the present Broach cotton when grown pure, will also prove superior to it in yield and ginning percentage. We are, therefore, of opinion that its main energies in the Broach *deshi* tract should be devoted to this purpose and that it should do nothing to promote the spread of *goghari* until the question of the value of this variety relative to Broach cotton has been definitely settled. We would suggest that specially selected strains from the Surat farm should be tried in the Broach tract and that the Broach farm should be enlarged and utilized, not only for tests of this character but also as a seed farm, *i.e.*, for the multiplication of the seed of any strain which it is decided to give out on a field scale. In regard to the Surat tract, we consider that it has been definitely established that the varieties evolved on the Surat farm are superior to the ordinary cotton of the Surat tract though they are not equal to the best Navsari cotton. The extension of the cultivation of these varieties is, therefore, in the main, one of organization, a point in regard to which we have made recommendations below. We would merely state here that, if any permanent improvement is to be effected, the control of seed distribution must remain in the hands of the Agricultural Department and that it is essential that the improved strains should be grown in whole villages in compact areas. We are of opinion that the work on the Surat farm should continue on its present lines and that efforts should be made to evolve strains at least equal to, if not superior to, the best Navsari cotton. We would add that we hold the view that, both here and elsewhere, the Agricultural Department should come to a definite

decision as to which of its strains is superior and should confine the distribution of seed to that strain only, until it is satisfied that another is really better. It follows, therefore, that we approve the recent action of the Department in giving out the seed of Selection IA only.

126. In regard to the botanical work which should be done in the

(iii) **Khandesh tract.**

Khandesh tract, we would refer to our recommendations in the chapter on the Central Provinces and Berar, as the problems in this tract are much the same as in those provinces and we consider that a similar policy should be followed in both cases. We think it has been established that *bani* (*G. indicum*) is not suitable for this tract but we are of opinion that it is desirable that attention should be devoted to the improvement by selection or hybridization of the yellow flowered varieties in the present mixture, *G. neglectum malvense* and *G. N. verum*. The aim should be to evolve a strain of these which, whilst superior to *roseum* in staple, is at least equal to it in yield and ginning percentage. If this proves impossible, then, as in the Central Provinces and Berar, we are of opinion that every effort should be made to cover the whole tract with *roseum*. Meanwhile, until a final decision on this point has been reached, we consider that the work which is being done in promoting the cultivation of *roseum* in a pure state should continue on its present lines. We would recommend that special attention should be paid to hybridization as selection by itself may not prove sufficient to bring about the required result. It is very desirable that botanical work on Khandesh cotton should be carried on in close co-operation with the Agricultural Department in the Central Provinces as the work should have an important bearing on similar problems, in the adjacent tracts of those provinces and *vice versa*. As the best Khandesh cotton is grown in the neighbourhood of Dhulia, we consider that a better centre than Jalgaon for the botanical work we have recommended. We would add that the seasons of 1916 and 1917, in which the rainfall was abnormal, appear to have shown that the yellow flowered varieties recover more quickly and decidedly from the effect of heavy rain than the white flowered and that, owing to this, the cultivators have reverted to some extent to the practice of mixing the different varieties. This furnishes an additional argument in favour of intensive botanical work on the yellow flowered varieties.

127. We are of opinion that the botanical work which has been done by the Bombay Agricultural Department on the

(iv) **Kumpta Dharwar tract.**

(a) **Kumpta and Dharwar Broach.**

kumpta variety has been carried out on sound lines and that it should continue on the same lines. Whilst we regard both Selection I and the *kumpta* cross as strains which show great promise, we consider that the decision of the Agricultural Department to give out seed of Selection I in preference to that of the *kumpta* cross is correct. The length of the growing season of the former renders it more suitable to the climatic conditions of the tract. It gives a better yield than the *kumpta* cross and, although its ginning percentage is somewhat lower, it may prove

to be quite as high when the strain is grown on a field scale. Here as in the Broach tract, we are not in favour of the distribution of two strains simultaneously and are of opinion that the Agricultural Department should confine itself to the one which it considers superior from an all round point of view.

In view of the small success which has been achieved during the last ten years in introducing Broach cotton into the Kumpta-Dharwar tract and the fact that fresh seed has to be imported annually, we question the advisability of devoting much attention to this variety and do not recommend that any further botanical work should be done on it. The organization of the auction sales of the cotton produced has, in itself, involved the expenditure of a vast amount of time and trouble and experience has, in our opinion, shown that this might have been more profitably directed into other channels.

128. We consider that the question of the improvement of Dharwar American cotton has not received the attention that the importance of this variety merited.

(b) **Dharwar American and Cambodia.** This has been due, in a large measure, to the diversion of the energies of the Agricultural Department to Cambodia and to the inadequacy of the staff to work on both varieties. We approve the policy of the Department in endeavouring to eliminate New Orleans from the mixture and are of opinion that more intensive work on the improvement of the Upland type by selection or hybridization is required. We regard this as a matter of some urgency.

As in the case of Dharwar Broach, we consider it somewhat unfortunate that the Agricultural Department has devoted so much attention to Cambodia which experience has now shown cannot take the place of Dharwar American in this tract and can never be anything but subsidiary to it. The staple of Cambodia cotton in Dharwar is not more than $\frac{5}{8}$ ths inch in length and the fact that it is grown mixed with Dharwar American to such a large extent makes it almost certain that the cotton trade will never look to the Karnatak as a source of supply for Cambodia. We are, therefore, of opinion, that botanical work on this variety should be abandoned and that the Agricultural Department should concentrate on the main American cotton of the tract—the Dharwar American type. The problems connected with *kumpta* and Dharwar American are of sufficient importance and difficulty to justify the Department in devoting itself entirely to them and it is not desirable, in our opinion, that it should branch off into any by-paths.

129. We have little to recommend in regard to improvements in cultivation, in view of the work which has already been done in this direction. If the staff of the Department is increased in accordance with the proposals we have made below, more rapid progress in the introduction of such improvements as the cultivation of leguminous crops, green manuring, square planting and the use of iron ploughs, should be possible. A drill that will automatically drop seeds at proper intervals

is a desideratum both in the Bombay Presidency and elsewhere and is a matter to which Agricultural Engineers are giving their attention. As already stated in paragraph 118, the Agricultural Department has experimented with steam and power ploughs in Gujarat and the Kumpta-Dharwar tract with a view to the eradication of deeply rooted weeds and grasses. A charge of Rs. 25 per acre is levied in the latter tract, whilst in Gujarat, where it is not necessary to plough so deeply, it is Rs. 13 per acre. The charge barely covers expenses in the Karnatak but leaves a small profit in Gujarat. We consider that there is great scope for an extensive development of deep ploughing and that such a development would have an appreciable effect on the outturn of cotton. But if steam and power ploughing is to prove a practicable proposition, it is necessary that a programme should be laid down which will keep the machinery fully employed. The subject is one which should be thoroughly investigated and the possibility of handing over the work to a private agency subsidized, if necessary, by Government at the outset deserves consideration.

130. The organization evolved for the distribution of the seed of improved strains and of *roseum* as well as for the disposal of the produce raised from it differs in the different cotton growing tracts of the Presidency. Since the break down of the operations of the Surat Syndicate, the improved strains given out by the Agricultural Department from the Surat Farm have been grown in six or seven villages. These villages have been formed into a group and the cultivators in each village select one or two of their number who form a committee of which the Divisional Superintendent of Agriculture is Chairman and which supervises everything connected with the cotton from the distribution of seed to the marketing of the produce. The lint is at present purchased by the firm of Messrs. Narandas Raja Ram and Company at a premium of Rs. 12 per *khandi* over the price of the local cotton, the seed being returned to the Agricultural Department and stored on the Surat farm to be distributed the following season. The premium over ordinary Surat cotton is equal to seven per cent. and represents an increase in the value of the produce of an acre of land of rather over Rs. 4. The Director of Agriculture estimates that, on the basis of the valuations obtained during the last five years, the premium should be at least thirteen per cent. In Khandesh, the policy, which was first followed, was to multiply the seed of the *roseum* cotton produced by the Department through the agency of registered seed growers, who were selected from amongst good cultivators all over the tract. A beginning was made with thirteen of these in 1912-13 and, in 1916-17, the number of seed plots had increased to thirty-two. It was, however, found that the output of seed was not equal to the demand for it and, in consequence, seven seed societies were formed in 1916-17. These societies obtain seed from the Government farm at Jalgaon which is given out to a few of the members who have specially good land and have also a reputation for agricultural skill. Amongst the conditions under which such members grow the seed are that the first two pickings should be kept separate and

should be ginned at a factory selected by the managing committee of the society and that the growers should sell the lint separately and hand over the seed to the committee at a price to be fixed by it. In addition to these seed societies, four co-operative sale societies have recently been established in Khandesh. The main object of these societies is to secure for their members the full value of their cotton but the members of the managing committee do what they can to instruct the growers in the importance of using improved seed and of picking their cotton clean. It should be mentioned that a cotton market on the lines of those in the Central Provinces and Berar has recently been established at Bodwad in East Khandesh on the initiative of the Mamlatdar of Bhusawal and that efforts are being made to establish similar markets in other places. We are, however, of opinion that if such markets are to be successful, legislation to provide for their control is necessary and have made recommendations on this point in Chapter XVI. In the Kumpta-Dharwar tract, auction sales of the Dharwar Broach and Cambodia varieties have been organized by the Department since these varieties were produced on a commercial scale. Auctions of the Dharwar Broach variety commenced in 1910-11, and for Cambodia in 1912-13. The cotton sold at these auctions is grown under the supervision of the Department. Only cotton produced by certified growers is accepted as the cotton is sold by auction under the guarantee of the Department. On arriving at the auction ground, the cotton is separated into lots according to its ginning percentage. The quantities of Cambodia disposed of at these auctions have been very small. The maximum quantity of Broach which has so far been sold was 3,460 *nagas* (of 1,344 pounds each) in 1913-14, when the extra profit realized by the cultivators as the result of cultivating this variety was estimated at Rs. 40,595. The figures in 1916-17, had fallen to 265 *nagas* and Rs. 14,434 respectively and even these represented a very considerable advance on those of the previous year. The fact that the Broach and Cambodia varieties have made so little progress in the Kumpta-Dharwar tract in spite of the success of the auction sales in securing a fairly substantial premium for them, furnishes, in our opinion, sufficient evidence of their unsuitability for it. The policy of multiplying the seed of selected strains through the agency of registered growers has only recently been adopted in this tract. Four co-operative societies have also very lately been formed and, in 1916-17, two of these societies sold Broach and Cambodia cotton by public auction, whilst all four sold cotton for their members by private treaty.

131. Though, both in the Broach and Kumpta-Dharwa tracts, the Agricultural Department has evolved strains of cotton which are definitely superior in every way to the local cotton it must, we think, be admitted that the results of the efforts to promote the cultivation of these strains have been distinctly disappointing. This has, in our opinion, been mainly due to the inadequacy of the staff of the Department which has, it may be repeated, been able to do practically no work in the Dholleras tract. It is only in the Khandesh tract that any measure of success in putting out a variety of cotton which has any advantages

over the indigenous cotton has been achieved. Work in both the Broach and Kumpta-Dharwar tracts presents peculiar difficulties in that the improved strains are strains of the indigenous varieties and are therefore not easily distinguishable from them as is the case with Punjab American in the Punjab, Cambodia and *karunganni* in Madras and *roseum* in the Central Provinces and Berar, the varieties which have made the most striking progress in recent years. In these circumstances, it is obvious that a strong organization is necessary, if the improved strains are to be successful. The closest supervision over seed distribution, over the actual cultivation of the cotton and over the disposal both of seed and lint is essential but, in Bombay, there has not been sufficient staff available for this. In addition to inadequacy of staff, other causes have, in our opinion, contributed to the slow progress of the improved strains. The failure of the operations of the Surat Syndicate undoubtedly deeply discouraged the Department which has since then done little more than mark time in the Broach tract. In the Kumpta-Dharwar tract, the efforts of the Department have, as we have already mentioned, been devoted more to work on Broach and Cambodia than on *kumpta* and Dharwar American. We wish here to record our opinion that the Department was, in every way, justified in its efforts to introduce these cottons. Experience alone could show that they were not entirely suited to the conditions of the tract. Now that such experience has been obtained, we think that the correct policy is to abandon further work on them and to concentrate on the indigenous cottons of the tract.

It is not an easy matter to make recommendations in regard to the best methods of pushing improved strains of cotton in Bombay. The difficulty arising from the fact that the cultivator is not willing to grow such strains unless he is convinced that they will pay him well and that it is not possible to secure a sufficient premium until they are produced in commercial quantities has perhaps been felt more acutely in Bombay, especially in the Broach tract, than elsewhere. The prospects of success for an improved strain are obviously most hopeful when it is grown almost at the outset on a fairly large scale and, at the same time, a suitable organization for marketing the produce is established. It is necessary that the two should synchronize as far as possible and they can only do so if the staff of the Agricultural Department is both adequate and efficient. An essential preliminary to the production of cotton in anything like commercial quantities is that a sufficient supply of seed should be available. Although much may be done by means of registered growers and seed societies, we are of opinion that this is not sufficient and that, in order that the Department may be in a position to put out large quantities of the seed of its improved strains, more seed farms are immediately required, both in the Broach and Kumpta-Dharwar tracts. We would, therefore, recommend that steps should be taken at once to secure suitable land for this purpose.

In regard to the organization for marketing the produce of improved strains of cotton, we would state that, after close examination of the working of the buying syndicates both in Sind and Surat, we are con-

vinced that this method offers the smallest prospects of success. We have dealt with this subject at some length in Chapter XVI and have there pointed out that a buying agency is only likely to prove successful if the cultivators are compelled to dispose of their cotton to it, a measure which we are unable to recommend. We entirely approve the beginnings which have been made both with co-operative seed societies and sale societies in Khandesh and the Karnatak but, unless progress proves to be much more rapid than there is at present reason to consider probable, it is obvious that it must be many years before these do more than touch the fringe of the problem, more especially as the co-operative movement has made small progress in the very important cotton tracts of Gujarat. We consider it most desirable, however, that every effort should be made to extend the numbers and activities of these societies. On the whole, we are of opinion that, in the conditions prevailing in Bombay, the system of auction sales is the most likely to solve the problem of obtaining for the cultivator the full value for long staple cotton. In view of the close proximity of the cotton tracts in the Bombay Presidency to the chief centre of the cotton trade in India, the successful organization of such sales should present fewer difficulties than in other parts of India. But, if such sales are to be successful, it is necessary that the Agricultural Department should keep the closest control over them for some years to come and until the system is sufficiently developed to be taken over by other agency. For this reason, we are somewhat doubtful about the wisdom of handing over the conduct of the auctions in the Kumpta-Dharwar tract to co-operative societies, more especially as the Director of Agriculture himself is of opinion that, whilst co-operative societies are quite competent to manage credit business successfully, it is difficult to get them to take sufficient trouble in handling a commodity such as cotton. If the system of auctions by co-operative societies is continued, the auctions should be closely supervised by the Agricultural Department. We consider it advisable that the cotton should be sold, as far as possible, on the basis of purity rather than of ginning percentage. It will be obvious that if the cotton is that raised from the seed of improved strains given out by the Agricultural Department, and is certified as pure by that Department, the trade will have sufficient information and sufficient guarantee as to its staple.

In connexion with the subject of this paragraph, we would draw attention to our recommendation in Chapter XVI that efforts should be made to establish open markets on the Berar system in the cotton tracts of the Bombay Presidency. The fact that the cotton growing areas in the Province are more concentrated than in most other parts of India and their close proximity to Bombay should very materially reduce the difficulty of establishing such markets.

132. Irrigated cotton in Bombay is grown entirely under wells and there does not appear to be any prospect of its competing with such crops as rice or sugarcane under canals or tanks. The greatly increased yields of cotton which have been obtained under wells in the Kaira

Prospects of long staple cotton under irrigation.

District should, however, be mentioned and point to the desirability of increasing the number of wells in North Gujarat. We would, therefore, suggest that loans (*takavi* advances) under the Land Improvements Loans Act, XIV of 1880, should be granted with some liberality for this purpose. The possibilities of replacing bullock power by pumps have already been investigated by the Agricultural Department and considerable progress has been made in this direction.

133. The Bombay Presidency proper is at present divided into three

**Recommendations in
regard to staff.**

Circles for agricultural purposes. The Northern Circle comprises the districts of Ahmadabad, Kaira, Panch Mahals, Broach, Surat, East Khandesh, West Khandesh, Nasik, Ahmednagar and Poona. The Southern Circle comprises the districts of Dharwar, Belgaum, Bijapur, Satara and Sholapur. The Konkan Circle is made up of the districts of Thana, Kolaba, Ratnagiri and Kanara. The Northern and Southern Circles are normally in charge of a Deputy Director of Agriculture who is a member of the Indian Agricultural Service whilst the Konkan Circle is in charge of an extra Deputy Director, who does not belong to that service. It will be evident from the mere enumeration of the districts comprised in each circle that the superior staff of the Agricultural Department is seriously inadequate to the work with which it has to deal. The Northern Circle is a specially unwieldy circle, comprising as it does not less than three of the four main cotton growing tracts of the Presidency, the Dholleras, Broach and Khandesh tracts. In view of the specially difficult nature of the cotton problems in Bombay and of the necessity for a strong organization which we have emphasized in the preceding paragraphs of this chapter, we are of opinion that the division of this circle into three circles is very urgently required. Ahmadabad, Kaira and Panch Mahals should form one circle, Broach and Surat a second whilst the third should comprise the districts of East and West Khandesh, Nasik, Ahmednagar, Sholapur and Poona. We recommend the excision of Sholapur from the Southern Circle, and its addition to the third circle proposed above as it is desirable that the whole of the area which grows Khandesh cotton should be in the same circle. We are aware that the Dholleras and Broach Circles, the formation of which we have suggested, will be unusually small in point of area, but we are of opinion that the cotton problems in these circles are of such exceptional difficulty that our recommendations in this respect are fully justified. We consider that the staff proposed is the minimum required if conditions in regard to cotton in this tract are to be placed on a thoroughly sound basis. We would point out that the Deputy Director in charge of the Dholleras Circle should be able to render assistance to the Native States in Kathiawar and that both he and the Deputy Director in charge of the Broach Circle should work in close touch with the Agricultural Department in the Baroda State. The Southern Circle should, in our opinion, remain as at present except that the Sholapur district should be taken from it and added to the Khandesh Circle. In view of the fact that there are two quite distinct varieties of cotton grown in this circle which makes it a very heavy charge for one officer, we consider it

advisable that the Deputy Director of Agriculture in charge of it should be given the assistance of an Assistant Director of Agriculture, who should be a member of the Indian Agricultural Service. We regard this as preferable to an attempt to form the Dharwar American tract into a separate circle as where that variety is grown, it is often mixed with *kumpta*. The net result of our recommendations is, therefore, the addition of two Deputy Directors and one Assistant Director to the superior staff of the Bombay Agricultural Department.

The present position in regard to botanical work is that the Province has two Economic Botanists. The senior of these is Professor of Economic Botany at the Poona Agricultural College and is fully engaged in teaching work and in work on fruit, millets and fodder crops, whilst the other, who has only recently been appointed, is devoting his attention mainly to rice. Neither of them has done any work on cotton, mainly because the advice and assistance of the Imperial Cotton Specialist, whose headquarters are at Poona, have always been available and, in fact, his principal work has been on the cottons of Bombay. We have, however, recommended in Chapter XIX that the appointment of Imperial Cotton Specialist should be abolished on the retirement of the present holder and, if this recommendation is accepted, the Bombay Agricultural Department will no longer be able to avail itself of his services. As we stated at the commencement of this chapter, we regard the botanical problems in Bombay as more complex and difficult than in any other part of India. The scope for botanical work on cotton in this Province is, therefore, particularly wide and, in these circumstances, we are of opinion that three additional botanists should be added to the Agricultural Department, one for the Dholleras and Broach tract, a second for the Khandesh tract and a third for the Kumpta-Dharwar tract. The creation of the first of these appointments we regard as especially urgent, in view of the very small amount of work which has hitherto been done on Dholleras.

134. Before concluding this chapter, we wish to emphasize the importance of the Native States in Bombay from the point of view of cotton cultivation. The area under cotton in these States is over a third of the total area under cotton in the Presidency, exclusive of Sind, and forms nearly one-tenth of the total area under cotton in India. It is especially high in the Kathiawar States, whilst, in the south of the Province, the States of Kolhapur, Sangli, etc., grow large areas of *kumpta* cotton. It may be mentioned that the States of Morvi, Wadhwan, Muli, Wankaner, and Lakhtar in Kathiawar grow *wagad* and *kanvi* unmixed whilst patches of *ladio* are grown under irrigation. In addition to these varieties, the remaining States in Kathiawar grow *mathio* over large areas and this, at present, makes up the larger proportion of the total. Time unfortunately, did not permit of our visiting any of the Native States in Bombay but we understand that many of their rulers and high officials take a keen interest in the agricultural development of their territories and that, in some cases, they employ trained agricultural

Kathiawar and other Native States.

officers who work in co-operation with the Bombay Agricultural Department. We would suggest for consideration the possibility of appointing an experienced agriculturist as Agricultural Adviser to the small States which cannot afford to employ, on their own account, an officer of the standing of an Assistant Director of Agriculture. We also consider it desirable that all the States throughout the Province should decide, in consultation with the Bombay Agricultural Department, which type of cotton they wish to encourage in their territories. The necessity that any work on cotton in the States should be carried out in close co-operation with the Bombay Agricultural Department need hardly be insisted on.

135. Our recommendations and conclusions in this chapter may be *Summary.* summarized as follows :—

In regard to botanical work :—

- (1) The relative value of the constituents of the Dholleras mixture should be definitely ascertained in order that the Agricultural Department and the cotton trade may be in a position to decide what steps should be taken in regard to them.
- (2) In the meantime, efforts should be made by persuasion and encouragement and by the provision of facilities for obtaining pure seed, to maintain the purity of *wagad* in the neighbourhood of Viramgam and to restore *lurio* to its former purity in the Ahmedabad and Kaira Districts and in the adjoining parts of Baroda and Kathiawar.
- (3) In the Broach *deshi* tract, the Agricultural Department should endeavour to evolve a type of Broach cotton as superior to *goghari* in staple as is the present Broach cotton when grown pure and also superior to it in yield and ginning percentage.
- (4) Work on the Surat farm should continue on its present lines, but efforts should be made to evolve strains at least equal to, if not superior to, the best Navsari cotton which could be given out in the Surat tract. Only one improved strain of cotton should be given out at a time.
- (5) In the Khandesh tract the aim of the Department should be to evolve by selection and hybridization, a strain of the yellow flowered varieties, such as *G. neglectum malvense* and *G. N. verum* superior to *G. N. roseum* in staple and at least equal to it in yield and ginning percentage.
- (6) In the Kumpta-Dharwar tract, the work of the Department on the *kump'a* variety should continue on its present lines but only one improved strain of that variety should be given out at a time.

- (7) The efforts to eliminate the New Orleans type from the Dharwar American mixture should continue and more intensive work should be done on the Upland type by selection and hybridization.
- (8) No further botanical work should be done on the Dharwar Broach and Cambodia varieties.

In regard to agricultural work :—

- (9) The possibilities of steam and power ploughing should be further investigated and the possibility of handing over the work to a private agency subsidized, if necessary, at the outset by Government should be considered.
- (10) Steps should be taken to increase the number of seed farms in the Broach and Kumpta-Dharwar tracts.
- (11) Efforts should be made to extend the number and activities of co-operative seed unions and sale societies.
- (12) Efforts should be made to organize auction sales of the *kapas* of the improved strains of cotton in the Broach and Kumpta-Dharwar tracts, the *kapas* being sold on the basis of purity rather than of ginning percentage.
- (13) The policy of handing over the control of auction sales to co-operative societies is of doubtful expediency but, if it is continued, such sales should be closely supervised by the Agricultural Department.
- (14) No further efforts should be made to push the Broach and Cambodia varieties in the Kumpta-Dharwar tract.
- (15) The work on pushing *roseum* in the Khandesh tract should continue on its present lines until a final decision has been reached in regard to the possibility of replacing this variety by an improved strain of *neglectum* cotton. If this is found impossible, vigorous efforts should be made to cover the whole tract with *roseum*.
- (16) Efforts should be made to establish open markets on the Berar system in the cotton growing tracts of the Presidency.
- (17) Loans under the Land Improvements Loans Act for the construction of wells should be granted with some liberality in North Gujarat in view of the greatly increased yields of cotton which have been obtained under wells in that tract.

In regard to agricultural staff :—

- (18) The Northern Circle, with the addition of the Sholapur district from the Southern Circle, should be divided into three Circles, the Dholleras, Broach, and Khandesh tracts, each forming a separate circle.
- (19) An Assistant Director of Agriculture, who should be a member of the Indian Agricultural Service, should be appointed to the Southern Circle which should no longer include the Sholapur district.

- (20) Three additional botanists should be appointed to the Province, for the Dholleras and Broach, Khandesh, and Kumpta-Dharwar tracts respectively.

In regard to cotton in Native States :—

- (21) The possibility of appointing an experienced agricultural officer as Agricultural Adviser to the small States which cannot afford an officer of the standing of an Assistant Director of Agriculture should be considered.
- (22) All the Native States in the Province should decide, in consultation with the Bombay Agricultural Department, which type of cotton they wish to encourage in their territories.

CHAPTER VIII.

Madras.

136. The area of the Madras Presidency according to the figures for 1915-16, is 91,046,722 acres, exclusive of Native States. The net area actually cropped during the five years ending 1916-17 averaged 34,449,000 acres, of which 2,280,000 acres were under cotton. In addition, the Native States of the Province returned an average area of 24,000 acres under cotton for the five years ending 1916-17. The percentage of the area under cotton to the total area cropped was 6.6. Although this percentage is considerably exceeded by the Central Provinces and Berar, Bombay, Hyderabad and Baroda, Madras is one of the most important Provinces from our point of view, as it at present produces more long staple cotton than any other part of India. Out of a total crop of about 500,000 bales, very nearly half falls under our definition of long staple cotton suitable to Lancashire whilst practically the whole of the remainder, with the possible exception of the cotton produced in the Coconada tract, is long staple cotton as defined by the Bombay cotton trade. The percentage of the area under cotton in Madras to the total area under cotton in India averaged 10.2 for the five years ending 1916-17.

137. The cotton tracts of Madras fall into three fairly well-marked divisions. The first of these is the Deccan table-land, comprising the districts of Bellary, Kurnool, Anantapur and Cuddapah, in which the varieties known as "Westerns" and "Northerns" are grown. The second tract lies along the east coast of the Peninsula and comprises the districts of Guntur, Kistna, Nellore and Gcdavari, of which Guntur is much the most important. This tract produces the cotton known by the trade as "Coconadas." The third tract comprises the southern districts of Tinnevely, Ramnad, Coimbatore, Madura and Trichinopoly. This, again, has two subdivisions, Cambodia cotton being grown on the red soils throughout and being by far the most important crop in the Coimbatore district, on the black soils of which *uppm* is the only *deshi* cotton grown. On the black soils of the remaining districts, the varieties known as *karunganni* and *uppm* are grown either mixed or pure. The distribution of the different varieties is dealt with in detail in the following paragraph, but it may be mentioned here that although the *uppm*, *nadim* and Bourbon varieties pass under the trade name of "Salems," the area under cotton in the Salem district is insignificant, being only about 7,000 acres.

Of the cotton growing tracts, Tinnevely has the highest annual mean temperature, which is due less to great heat in the summer than to absence

of moderate coolness in the cold season. The climate of the Deccan table-land resembles that of Berar, being marked by great heat in March, April and May and being fairly temperate for the rest of the year. The average rainfall in the cotton growing districts varies from 22.66 inches in Bellary to 39.40 inches in Godavari. Whilst all districts get rain both from the south-west and north-east monsoons, the bulk of the rainfall in the Deccan and east coast districts is received from the south-west monsoon. In the south, the position is reversed, Tinnevely getting only 3.10 inches of rain in the south-west monsoon months against 17.79 inches from the north-east monsoon. Bellary with a rainfall of 22.66 inches and Coimbatore with one of 26.16 inches are the two driest districts in the Presidency.

The soil on which most of the indigenous cotton of the Presidency is grown is the well-known retentive black cotton soil which, however, is not such a rich soil as in Berar and is often saline and shallow. In the Deccan districts, indigenous cotton is also grown on red soils, mostly loamy in character, whilst in the south, Cambodia is almost entirely grown on such soils. Except in the case of Cambodia, of which a large proportion is grown under well-irrigation, cotton in the Madras Presidency is a "dry" crop, i.e., is dependent solely on rainfall. The "dry" soils even of the black class are, generally speaking, deficient in organic matter and other constituents of vital importance, such as humus, phosphoric acid and nitrogen whilst lime is in defect in the red soils. The outturn of cotton per acre in Madras is in consequence lower, both on irrigated and unirrigated soils, than in any other Province in India.

138. The cotton known by the trade as "Northerns," which is grown in the Kurnool district and in parts of the Cuddapah and Anantapur, the chief centres being Nandyal, Proddatur and Tadpatri, is a mixture of *Gossypium herbaceum* Madraspatna and *Gossypium indicum*, the former predominating on black soils, whilst, on red soils, *G. indicum* is the chief ingredient of the mixture, being frequently grown almost in a pure state. A large proportion of the cotton has a reddish tinge and is considered superior in quality. The average length of the staple of "Northerns" cotton is $\frac{3}{8}$ ths inch and its average ginning percentage 27.

The cotton which passes under the trade name of "Westerns" is grown in the Bellary district and the adjacent Gooty taluk of the Anantapur district and Pattikonda taluk of the Kurnool district. It consists almost entirely of *G. herbaceum*, but there are traces of *G. indicum*. The staple of "Westerns" cotton is $\frac{5}{8}$ ths inch in length and is therefore shorter than that of "Northerns." Its ginning percentage is also lower, being only 25.

Cambodia and Dharwar American (*G. hirsutum*) as well as *G. neglectum* are found on small areas in both the "Northerns" and "Westerns" tracts. Until last year, when Dharwar American was introduced on a fairly large scale into the "Northerns" area round Tadpatri, this variety was found mainly on red soils in the west of the Bellary district.

G. neglectum is grown on red soils in the neighbourhood of Adoni in the Bellary district where it appears to be spreading with some rapidity. Such soils, however, form only about ten per cent. of the cotton area. A recent examination of the cotton grown on them has shown that although typical *roseum* occurs, the bulk of the crop consists of superior types of *neglectum*.

139. The variety of cotton known as "Coconadas" which is grown in scattered tracts in the Guntur district and in

(ii) **Coconadas.** parts of the Nellore, Kistna and Godavari districts, appears to contain many types but is classified by Mr. Gammie as *G. obtusifolium* Coconada and *G. indicum* (*yerra patti*). The larger part of the "Coconadas" crop which is produced on the typical black cotton soils of the Guntur district and the Nandigama taluk of the Kistna district has a reddish tinge and, as in the case of "Northerns," is superior to the remainder of the crop. The cotton grown on the fringes of the tract, where the soils are poor black or red, is whiter in colour but shorter and weaker in staple. The average length of the staple of this variety appears to be about $\frac{5}{8}$ ths inch to $\frac{7}{8}$ ths inch and its ginning percentage about 23. It should, however, be mentioned that this cotton has so far received no attention from the Agricultural Department and, in consequence, we received very conflicting evidence in regard both to length of staple and ginning percentage, the estimates for the former varying from $\frac{5}{8}$ ths inch to $1\frac{1}{8}$ ths inch and for the latter from 21 to 26 per cent.

140. The indigenous cotton grown in the Tinnevely, Madura and Ramnad districts, known to the trade as (iii) **The Southern Districts.** "Tinnevellies" now falls under two main classes. Upto about 1907, the variety known as *karunganni*, a variety of *G. indicum*, was grown in those districts mixed with *uppam* (*G. hercaceum*), its cultivation as a pure crop being confined to a few villages in the extreme south of the tract. The work of the Agricultural Department on *karunganni*, described below, has resulted in the evolution of two superior strains of this variety and it is estimated that about half the cotton tract which produces "Tinnevellies," is now sown with these. *Uppam* in the remainder of the three districts is being gradually replaced by *karunganni* but is still grown comparatively pure on black soils in the Coimbatore and Trichinopoly districts, where, as already stated, it passes under the trade name of "Salems." In the Coimbatore district it is, however, being replaced by Cambodia grown as an unirrigated crop. The staple of the superior varieties of *karunganni* distributed by the Agricultural Department is at least $\frac{7}{8}$ ths inch, which makes it one of the finest indigenous cottons in India and their average ginning percentage is 32. The staple of the remainder of the cotton grown in the three districts of Madura, Ramnad and Tinnevely, which is now *uppam* with an admixture of *karunganni*, is $\frac{5}{8}$ ths to $\frac{7}{8}$ ths inch and its ginning percentage 27. The staple of *uppam*, as a pure crop, is $\frac{5}{8}$ ths inch and its ginning percentage 25. *Pulichai*, a mixture of two varieties of *gossypium neglectum*, was introduced into the Tinnevely district about 1908, but its cultivation has now been practically exterminated. The only other

indigenous cotton of the Presidency is *nadam* (*G. obtusifolium*), a perennial cotton grown on light soils in the Coimbatore and Trichinopoly districts. Its staple is $\frac{3}{8}$ ths to $\frac{1}{2}$ ths inch in length and its ginning percentage 23. It is of very little importance, as it is only cultivated on light and precarious soils and the area under it is not more than twenty thousand acres. The two exotic cottons grown in the Presidency are Bourbon and Cambodia. Bourbon (*G. purpurascens*), like *nadam*, is a perennial cotton grown on light soils in the Coimbatore district. Its staple is at least an inch in length and its ginning percentage 25. It also is of small commercial importance, the area under it being only about ten thousand acres. The case is quite different with Cambodia cotton, a type of American Upland (*G. hirsutum*) the seed of which was obtained direct from Cambodia about 1905 by Mr. C. Benson, formerly Deputy Director of Agriculture. It was grown at the outset as an unirrigated crop on the black soil of the Koilpatti farm and, in such conditions, showed little promise. Its rapid extension throughout the southern districts of Madras was, in no small measure, due to the discovery by Mr. A. Steel of the firm of Messrs. A. and F. Harvey and Company of its possibilities as an irrigated crop on red soils. It is now grown on red soils throughout the southern cotton growing districts of Madras and, in the Coimbatore district, the bulk of the cotton area is under this variety. As already stated, it is the only cotton in Madras which is grown under irrigation and it was not until it was discovered that it flourished on light soils under wells that its success was assured. About two-thirds of the area under the Cambodia crop is, however, unirrigated and the crop on this is, in every way, inferior to that grown under irrigation. In point of fact, the total yield from the irrigated and unirrigated areas is approximately equal though the unirrigated area is twice as great as the irrigated. Estimates in regard to the length of its staple differ considerably, probably owing to the differing conditions under which it is grown, and vary from $\frac{3}{8}$ ths inch to $\frac{1}{2}$ ths inch in the case of the unirrigated crop and from $\frac{3}{8}$ ths inch to $1\frac{1}{8}$ ths inch in that of the irrigated crop. Its ginning percentage averages about 33. In the main, it has not replaced any other variety but has been introduced into tracts in which cotton was not already grown. It is now the most important variety produced in Madras both as regards acreage, outturn and length of staple.

141. The cultivation of cotton in the "Northerns" and "Westerns"

Cultivation of cotton.

tracts and in the black soils of Madura, Tinnevalley and Ramnad reaches a very high level. That of irrigated Cambodia is also exceptionally good. Both "Northerns" and "Westerns" are cultivated on black and red soils and are always sown with a drill. On black soils, "Northerns" cotton is usually sown in August and September with a small admixture of horse gram (*Dolichos biflorus*) and is succeeded in the following year by *juar* (*Sorghum vulgare*) mixed with green gram (*Phaseolus mungo*). On red soils, it is sown a little earlier and is usually mixed with Italian millet (*Setaria italica*), two lines of millet being sown to one of cotton. In this case also, the succeeding crop is usually *juar*, mixed with one or more pulses. "Westerns" cotton on black soils is sown in July and August

and on red soils in August and September. The rotation is much the same as in the "Northern" tract, cotton being sown mixed with Italian millet and being followed by a mixture of *juar* and pulses. The picking of "Northern" and of "Western" on black soils commences in February and continues till April. That of "Western" on red soils begins in October and as it is in boll during the north-east monsoon, the produce is usually stained. In both cases, the methods of picking are extremely bad. Picking does not commence till about 10 A.M. when the leaf, bracts and bolls are very dry and brittle and no care is taken to keep the cotton clean. In consequence, the *kapas* is marketed in a very leafy and dirty condition and mill reports show that the average blow-room loss is as high as eighteen per cent. As already stated, the Agricultural Department has done no work on Coconada cotton and we, therefore, received no information in regard to the cultivation of that variety, but it would appear to be more backward than that of the other cotton growing tracts of Madras. Cotton in the southern districts is a much later crop than in other parts of India. It is sown in October, picking commencing in February and going on as late as July. Throughout the black cotton soils it is sown broadcast. The Agricultural Department has, however, for some years past made strenuous efforts to introduce the practice of sowing in lines. These have been moderately successful and over 15,000 acres are now sown in this way. Except in the matter of broadcast sowing, the cultivation of cotton on the black soils of the Madura, Ramnad and Tinnevely districts is excellent. It usually follows a cereal which, in the south of the tract, is invariably *kumbu* (*Pennisetum typhoideum*), the *bajra* of other parts of India. In the north, *kumbu* is replaced to some extent by *varigu* (*Paspalum scrobiculatum*). Coriander is usually mixed with cotton, the proportion varying with the price of the former. Cattle manure, composted with tank silt, vegetable refuse, house-ashes, etc., is the main manure. This is always applied to the cereal crop as, owing to the lateness of the season in this tract, the vegetative growth would otherwise be too luxuriant and the ripening of the crop would be delayed until the hot weather set in with the result that the plant would lose its vigour and drop its bolls. In the black soils of the Coimbatore district, much less attention is paid to the question of rotation and cotton is sown year after year without manure. In Trichinopoly, cultivation is poor and cotton only forms a mixture with pulses and cereals which are sown broadcast together. The conditions under which Cambodia is grown are very variable. When it is grown under wells, the crop is usually manured with tank silt and cattle manure. Cultivation is much less efficient when it is grown as a "dry" crop and the effect of this on the length of staple is very marked. In some tracts, the crop is left on the ground for two or three years, although the yield after the first year is comparatively small. In such cases it acts as a host to insect and other pests. The reason assigned for this practice is that sufficient seed is not available for resowings. The fibre of the lint produced in the second and third years is weak and uneven. Another peculiar practice which came under our notice in some of the more out-of-the-way tracts is to pick the bolls green and to

open them out by hand in the sun. This method, which also has a very detrimental effect on the strength of the fibre, is said to be due to fear of theft.

142. The history of efforts to introduce exotic cottons in Madras dates, as does that of Bombay, from 1790 when Dr. Anderson distributed a variety of foreign seeds from Malta and Mauritius throughout the Peninsula. The only surviving relic of his labours is the Bourbon cotton mentioned above which became naturalized in the districts of Tinnevely, Salem and Coimbatore, largely owing to the exertions of a Tinnevely merchant named Hughes. In 1819 four cotton farms of four hundred acres each were established at Tinnevely, Coimbatore, Masulipatam and Vizagapatam, but the results obtained left no mark on cotton in Madras. Of the American planters who, as mentioned in the chapters on the United Provinces and Bombay, were brought to India in 1840, three were sent to Madras. They commenced work in the Tinnevely district where, however, the ryots refused either to adopt the American method of cultivation or to sow seed of American cotton unless Government guaranteed to buy the produce. They were consequently transferred to Coimbatore and, in 1842, Dr. Wight became Superintendent of Cotton Operations. Trials of New Orleans, Sea Island and Bourbon cotton were made on four farms which were opened in the Coimbatore district, but the Madras Government were so dissatisfied with the results that, in 1845, it was decided that two of the three planters should be sent to Bellary and Tinnevely respectively. The third, Mr. Simpson, was transferred to Bombay, Dr. Wight remaining in charge of the work in Coimbatore. Mr. Morris held out no hope of success with American cotton in Bellary, where he died in 1846. From 1847 to 1849, Dr. Wight and Mr. Finnie were engaged in a heated controversy regarding their respective methods which ended in the Madras Government terminating the engagement of both in 1849. The proceedings of the Local Government in Dr. Wight's case were reversed by the Court of Directors and his experiments continued until 1853 when, in consequence of further strictures on the meagre results produced, he retired from the service. With his departure, interest in the cultivation of exotic cotton ceased. Isolated experiments were carried on by private individuals, but it was not until the Saidapet farm was opened about 1878 that any systematic work was undertaken. New Orleans, Sea Island, Upland American, Yea Valley and Brazilian varieties were tried for many years on the farm, but the results obtained were of a negative character. For some years after the re-organization of the Madras Agricultural Department in 1905, American, Peruvian, Egyptian, Sea Island and Caravonica cotton were experimented with on the farms at Bellary, Attur, Taliparamba and Hagari, but with no success. Except in the case of Cambodia, the Agricultural Department has, in recent years, confined its attention to the improvement of the indigenous cottons, its work on which is described in detail in the subsequent paragraphs. We consider that its policy in this respect has been a sound one and, except to the

limited extent indicated below, do not recommend that any further experiments with exotic cotton should be undertaken.

143. Both on the Bellary farm, which was opened in 1901 and given up in 1912-13, and the Hagari farm which was opened in 1906-07, the main work of the Agricultural Department has been on "Westerns" cotton. The Nandyal farm in the Kurnool district, which was opened in 1906-07, was established mainly with a view to the study of "Northerns." In both cases, almost from the outset, seed selected in bulk was given out, but it was found that, in the Bellary district, the cotton grown from selected seed was in no way better than the ordinary local varieties. At Nandyal, however, the cotton grown from such seed which became known as "Sircar" cotton, was superior both in yield and ginning percentage. By 1913-14, the Agricultural Department was in a position to give out seed of a selected strain both at Hagari and Nandyal. The ginning percentage of the variety distributed at Hagari known as Hagari No. 1, was 27.3, against the local average of 25, the yield being equal to that of the local variety, but the length of staple superior. At Nandyal, the ginning percentage of the variety distributed, known as Sircar No. 2, was 30 per cent. against the local average of 25. In this case, the yield was equal to that of the local variety, but in every other respect, the strain was superior. Both varieties were of a fuzzy seeded *herbaceum* type, the produce of a single plant selected in 1907 at Hagari. These strains have been the only ones given out up to date in these tracts and neither of them has fulfilled expectations. Both were selected for good staple, colour and strength, the qualities desired by the cotton trade, but, as the Director of Agriculture pointed out in his report for 1916-17, the yield of lint per acre is the all important matter from the point of view of the cultivator as the difference between long and short staple cotton is not sufficient to compensate him for the poorer yield of the former. For this reason, as it has not so far been possible to find a strain combining long staple with high ginning percentage suitable for the "Northerns" and "Westerns" tract, the *neglectum* types, which appeared near Adoni for the first time on an appreciable scale in 1916-17, give promise of proving a serious rival to the local cottons on red soils. In these circumstances, the Agricultural Department has under consideration the question of discarding Hagari No. 1 in the "Westerns" tract, in favour of a new type known as No. 25, which appears very promising. In regard to "Northerns," it should be mentioned that the trade has, in the past, paid a small premium of about Rs. 5 per *khandi* of 500 pounds of lint for white "Northerns," in spite of the fact that the staple of red "Northerns" is superior. This tendency appears to have misled the Agricultural Department to some extent and resulted in its putting out the Sircar No. 2 variety, which is white in colour. Recent mill tests would, however, seem to have resulted in a change of policy on the part of the trade and, at the time of our visit to the "Northerns" tract, red and white "Northerns" were selling at the same price. The Sircar No. 2 variety is reported to have spread over the greater part of the tract and the ginning percentage of the cotton

produced in it has consequently increased from 25 to 27. The staple of this variety is, however, somewhat lacking in strength and uneven in feel and, owing to these disadvantages, the Agricultural Department has now stopped distributing it and is contemplating the distribution of a strain of *indicum* known as No. 14. This was one of the finest indigenous cottons we saw during our tour. The length of its staple is fully one inch but, whilst its outturn is good, its ginning percentage is only 25.

144. Selection work on "Tinnevelly" cotton has been carried on at the Koilpatti farm in the Tinnevelly district on much the same lines as at Hagari and Nandyal, but has proved much more successful. As already stated, up till about 1907, the cotton which passes under the trade name of "Tinnevellies" consisted of a mixture of *upparam* (*G. herbaceum*) and *karunganni* (*G. indicum*), the latter being grown pure only in a few villages near Tuticorin. Tests carried out on the Koilpatti farm, work on which commenced in 1902-03, soon showed the superiority of *karunganni* both in staple and outturn and, from 1907-08, the seed of this variety was purchased from selected growers and sown on an increasing scale. This seed was merely seed selected in bulk and not that of improved strains. By 1913-14, a type of *karunganni* had been more or less fixed on the Koilpatti farm as a result of the selection work carried out by Mr. H. C. Sampson, Deputy Director of Agriculture. Twenty acres of this type, which was known as Company No. 1, were grown on a field scale in 1912-13 and the seed obtained from this area was sold to selected villages throughout the cotton tract from Virudupatti to Tuticorin. In 1915-16 it was, however, decided to discard it on account of its persistently low yield. A variety known as Company No. 2, an unevenly ripening cotton with a ginning percentage of 30, was first given out in 1914-15 and Company No. 3, a variety which ripens early and evenly and has a ginning percentage of over 33, was distributed the following year. These two varieties have proved extremely successful and it was mainly owing to the fact that the Agricultural Department had, in the latter variety, a cotton which was able to hold its own both in yield and ginning percentage against *pulichai* (*roseum*) that enabled the successful campaign against that variety, which has been described in Chapter XVI, to be carried out. Selection work on *karunganni* is still being carried on at Koilpatti, and it is proposed to distribute a variety, known as Company No. 3A, which has given on the farm the very high yield for this tract of 171 pounds of lint per acre. It is also under contemplation to give out a mixture of Company No. 2 and Company No. 3, as, if an evenly ripening variety and one which ripens unevenly are distributed together, there is some guarantee that the cultivator will get a good outturn, it being very unlikely that the season will prove unfavourable for both.

145. The only botanical work so far done on Cambodia cotton has been a small amount of preliminary selection at (iii) Other varieties. Koilpatti and Coimbatore. Some selection work on *upparam* was done at the outset on the Koilpatti farm but, as the superiority of the *karunganni* variety as far as the Tinnevelly tract was

concerned had been demonstrated, this was abandoned and the Agricultural Department devoted its energies to the latter variety. Crossing between the Bourbon and Cambodia varieties has been tried at Coimbatore but has not yielded any definite results, mainly because it proved impossible to devote sufficient time to the work. We understand, however, that good material, which can be utilized as a basis for further experiments, is available. No botanical work has been done on *Cocconadas* or *nadam*.

146. We consider that the botanical work so far done on "Northerns,"

**Recommendations in
regard to botanical work.**

(i) "Northerns,"
"Westerns" and
karunganni.

"Westerns" and *karunganni* cotton has been carried out on thoroughly sound and scientific lines and, hence, have only a few comments to make in regard to it. In regard to "Westerns," we would point out that the spread of *neglectum*

types in this tract has introduced a new factor into the situation. *G. neglectum* is at present grown on red soils only, which form about ten per cent. of the area under cotton in this tract, and there does not appear to be any great danger of its spreading on the black soils. The problems in regard to this tract, therefore, fall under two heads, the improvement of "Westerns" on the black soils and the discovery of a type which can compete successfully with *roseum* or other *neglectum* varieties on red soils. The work done by the Agricultural Department in Tinnevely shows that there is reason to believe that both these problems can be successfully solved and the solution of the second should be rendered easier by the small proportion of the red soil areas. As regards work on "Northerns," we would point out that, on the basis of the present price of fifteen annas a pound for cotton, it is necessary that the cultivator should get a premium of about Rs. 25 per *naga* of 312 pounds of lint over the local "Northerns," if the variety No. 14, the ginning percentage of which is only 25, is to be successfully introduced. If, however, the ginning percentage of this variety could be worked up to 27, the general average for the "Northerns" tract, a small premium of about Rs. 5 per *naga* would be quite sufficient. We are, therefore, of opinion that efforts should be directed to this end. We would point out that any work on "Northerns" and "Westerns" carried out in Madras should also prove applicable to the adjacent tracts in Bombay and Hyderabad and we consider it desirable that this should be borne in mind. In regard to *karunganni*, it is sufficient to say that, whilst the distribution of a mixture of Company No. 2 and Company No. 3 will entail strict control of the seed supply by the Agricultural Department, this should not be difficult owing to the extent to which the Department has already gained the confidence of the cultivators in this tract. If it were found possible to isolate a type intermediate between these two types, work would be much simplified and we have little doubt that due attention will be paid to this point.

147. We consider that, before any botanical work can be done on

(ii) *Cocconadas* and *Cambodia*.

Coconadas, it is essential that a botanical and economic survey of the tract should be carried out. Work should then proceed on the same

lines as in the adjacent "Northern" tract. In view of the increasing importance of Cambodia both as regards area and length of staple, it is most desirable that botanical work on this variety should be undertaken at an early date. We regard this as the most urgent of the problems affecting cotton in the Madras Presidency. As the staple of Cambodia when grown under favourable conditions is at least an inch in length, this should be taken as the minimum staple in any work on this crop. The length of one of the selections on the Coimbatore Farm, which is looked upon with favour by the Agricultural Department, was stated to be .79 inch or only a little over $\frac{8}{10}$ ths inch. We consider that it would be fatal to the reputation of Cambodia, if any type were put out, the staple of which on the Government Farm only measures .79 inch. The argument that the premium that the cultivator can secure from the higher ginning percentage is certain whilst that he can secure from longer staple is indefinite does not, in our opinion, hold good in the case of Cambodia. There is no doubt that the reputation of this cotton already stands so high that the full value for longer staple can be more easily obtained by efficient organization than in the case of other longer staple varieties. We would point out, in this instance, as we have already done in regard to American cotton in Sind, that, for the purpose of comparing profits per acre, figures obtained from authoritative valuations are, in present conditions, more reliable than the prices actually fetched in the local markets, which are usually based on class and grade and not on staple. In this connexion, we would mention the possibility of evolving different types of Cambodia suitable to irrigated and unirrigated conditions respectively and the desirability of work on these lines

148. As already stated no recent botanical work has been done on *Uppam* cotton. It is, however, disappearing with some rapidity, Cambodia grown as an unirrigated crop replacing it in the Coimbatore and Trichinopoly districts and *karunganni* in the Tinnevely tract. In these circumstances, we do not recommend any botanical work on this variety and consider that in the southern districts, the Agricultural Department should concentrate its attention on *karunganni* and Cambodia. Whilst we consider that the experiments in crossing Bourbon and Cambodia should be recommenced and carried out on a scale that will enable definite conclusions to be reached, we are not in favour of independent botanical work on either the Bourbon or *nadam* varieties and should be glad to see the cultivation of these varieties entirely eliminated, if possible, as the insect pests, more especially the ring weevil, which they harbour, are a serious menace to other varieties of cotton, particularly to Cambodia.

149. We have already mentioned that the cultivation of cotton almost throughout the Madras Presidency is of a high order and have therefore few suggestions to offer in regard to its improvement. In the "Northern" and "Western" tracts, it has been found that the seed rate is not excessive and that the topping and thinning of cotton and

growing it unmixed with gram have not proved more successful than the local practice. The use of cattle and sheep manure increases the outturn, but the supply of such manure is limited. If Bengal gram were to precede cotton in the rotation, the yield of the latter would certainly be increased, but Bengal gram is an uncertain crop and its introduction into the rotation would mean that cotton would be grown only once in three years instead of every other year as at present. The cultivation of groundnut in these tracts is extending and this may prove a good substitute for Bengal gram. But here, as in the majority of the tracts in which the area under cotton forms a high percentage of the total cropped area, the great desideratum is a leguminous fodder crop which would yield heavily and could be grown either alone or mixed with *juar* (*Sorghum vulgare*) in alternate years. We would therefore recommend experiments with a view to discovering a suitable leguminous crop for these tracts. We would also mention that some of the soils in the "Northern" and "Western" tracts are badly infested with deeply rooted weeds and, as ploughing is seldom resorted to in such soils, the question of thoroughly cleaning the land by using steam or power ploughs, worked on a co-operative basis, appears to us to be worth investigation. Even more necessary than improvements in cultivation in these tracts is an improvement in the methods of picking, which are probably the worst in India. We would, therefore, draw special attention to our recommendations on this point in Chapter XVI and would state that the establishment of open markets in such centres as Nandyal, Adoni and Proddattur, on the lines we have advocated in that Chapter, as well as the provision of proper openers for *kapas* in the ginning factories is, in our opinion, very necessary. The establishment of such markets should do much to promote the adoption of better methods of picking. They would check the tendency to sell "forward" which is at present very prevalent in these tracts to the detriment of the quality of the cotton, as it is only in the case of cotton bought on the spot in open competition that the buyer is in a position to encourage the marketing of clean cotton. We would here add that the Coimbatore district is also, in our opinion, a tract in which the establishment of open markets is most desirable.

In the Tinnevely tract, the Agricultural Department has devoted considerable attention for many years past to the introduction of the practice of sowing in lines. It also manufactures and sells at cheap rates sets of implements suitable for sowing and interculture. We regard this work as of very great importance as it is only by such methods that improvements in cultivation can be introduced and bullock labour can be substituted for hand labour in weeding operations. We are, however, satisfied that the Madras Agricultural Department is doing everything possible in this direction and have, therefore, no specific recommendations to make under this head.

In regard to Cambodia, we consider it desirable that the question of suitable manures and rotations should be thoroughly investigated. Cambodia cotton is a more exhausting crop than *deshi* cotton, as its

root system is mainly a surface one. So far no suitable remedy has been discovered for the decrease in fertility this involves and it is therefore desirable that special attention should be paid to this point. We understand that a Bill has been introduced into the Madras Legislative Council, under which it will be possible to take action to stop the practice of allowing Cambodia to remain on the ground for more than one year. We need, therefore, only state that we are cordially in sympathy with the object of this measure as we consider that the continuance of this practice must have a detrimental effect on the staple of quality of Cambodia cotton. That it has not been without such an effect already is shown by the fact that we received a considerable amount of evidence in regard to the deterioration of Cambodia. We are, however, satisfied that there has been no real deterioration and that complaints of it have arisen partly as a result of the practice mentioned above and partly from the fact that the success of this variety has led to its extension to unirrigated black soils which are not suitable for it. Where grown on red soils under irrigation, it appears in every way to be up to its original standard. We would add that if the practice of allowing Cambodia to remain on the ground for more than one year is stopped by legislation, it is essential that the Agricultural Department should be in a position to supply good seed for resowings.

150. The Madras Agricultural Department has already an organization of seed farm and seed distribution, which only needs extension to rival that of the Central Provinces in efficiency. Such extension is mainly a question of staff, and we have little doubt that, when the superior staff of the Agricultural Department in the Presidency is brought up to its full sanctioned strength, progress will be very rapid. There are now about 1,900 acres in the Bellary and Kurnool districts and 1,700 acres in the Tinnevely tract on which pure seed is grown for the Agricultural Department under seed farm conditions, i.e., in which seed is grown by private landholders under arrangements with the Department. It is only, however, in the Tinnevely tract that a suitable organization for seed distribution has so far been evolved. In 1916-17, 362 ryots in 71 villages combined for the purpose of getting their cotton ginned and sold. In six villages, regular seed unions working under proper rules were constituted. The organization of these unions is as follows. A union consists of five or six ryots, who undertake to sow the whole of their cotton area with selected seed supplied by the Agricultural Department, to gin the cotton and sell the lint jointly under the supervision of the Department and to keep the seed for sale in the following season. To enable it to finance the sale of the seed, the union borrows, if necessary, from the local co-operative credit society, to which its members also belong. The Agricultural Department supplies it annually with sufficient fresh seed of selected strains to sow one-twentieth of the total area usually cultivated with cotton. This seed is sown by one member on his land which thus serves as a seed farm for the union, and the seed produced from this is used in the second year for all the cotton area of the union. In the third year, seed is available for outsiders and at

present is sold at double the price of ordinary seed. It is estimated that about 302,000 pounds of seed were sold for sowing by co-operative ginning and seed unions in 1916-17. Additional unions are being started and it is considered that the number will shortly be large enough to ensure a supply of pure seed to the whole of the Tinnevely tract. It will be seen that the system has much in common with that which has been adopted in the Central Provinces. We have no improvements to suggest and would only recommend that efforts should be made to introduce such unions into the other cotton growing tracts as soon as the Agricultural Department has any improved varieties which it can give out with confidence in these tracts.

151. As in the other major cotton growing provinces, we have examined the prospects of long staple cotton under irrigation, it should perhaps be mentioned that in Madras there is no question of cotton in any way competing with rice which is by far the most important irrigated crop. As already stated, no variety of cotton except Cambodia is irrigated and Cambodia is grown only under wells and not under canals or tanks. Whilst it is desirable that Cambodia should be grown as an irrigated rather than as "dry" crop, we do not consider that any special measures to promote this are called for.

152. Before coming to our recommendations in regard to the staff of the Madras Agricultural Department, it is necessary to mention that, under the reorganization scheme recently sanctioned, the Province is divided into seven Circles, each of which will eventually be in charge of a Deputy Director of Agriculture. Owing to the absence of officers on military duty and to difficulties in recruitment arising out of the war, the majority of the sanctioned posts are at present unfilled and there are only three Deputy Directors for the seven Circles. Had it not been for the war, the last two or three years would undoubtedly have seen a very striking development in the cotton work of the Presidency. The first Circle, which comprises the districts of Ganjam, Vizagapatam and Godavari, is not an important cotton growing tract though the Coconada variety is grown in the Godavari district. The second Circle, which comprises the districts of Kistna, Guntur and Nellore includes the greater part of the Coconada tract and we consider it desirable, in view of the small attention this tract has hitherto received, that a Deputy Director should be appointed to it at an early date. The survey of the cottons grown in it should, in our opinion, be carried out by a botanist and we have made further recommendations on this point below. The third Circle comprises the Kurnool, Cuddapah, Bellary and Anantapur districts and thus includes the whole of the "Northern" and "Western" tracts in the Madras Presidency. We have already emphasized the importance of these cottons and the magnitude of the problems which have still to be solved in regard to them. We consider that the two tracts are too heavy a charge for one officer and strongly recommend their division. We therefore propose a new Circle which

would comprise the "Northern" tract and the headquarters of which might suitably be Nandyal. The headquarters of the "Western" tract would remain as at present at Bellary. The fourth Circle comprises the districts of North and South Arcot, Chittoor and Chingleput, in which Cambodia is practically the only variety of cotton grown and that on a small scale. The main cotton crop of the fifth Circle which comprises the districts of Salem, Trichinopoly and Tanjore is *upham* though some Cambodia is grown in it. In the sixth Circle which is made up of the Madura, Ramnad and Tinnevely districts, *karunganni* is the most important variety though the area under Cambodia, especially on the red soils of Madura and Ramnad, is considerable. The seventh Circle includes the west coast districts and Coimbatore. No cotton is grown on the west coast but Coimbatore has large areas under both Cambodia and *upham*. We would suggest the sub-division of the fifth and seventh Circles into three Circles. The first of these would comprise the Tanjore and Trichinopoly Districts, the most important crops in which are rice and Cambodia cotton. The west coast districts would form a separate Circle whilst the remaining Circle would comprise the Coimbatore and Salem Districts, the most important crop in which would be Cambodia. This is, in our opinion, the most suitable method in which provision can be made for the work on Cambodia which we have recommended. Although under this division, Cambodia would be grown in three Circles, we consider that Coimbatore should be regarded as the centre for work on it. Our recommendations thus are that two additional Deputy Directors should be appointed, one with headquarters at Nandyal for the "Northern" tract and the other for work on Cambodia.

The Economic Botanist in Madras has so far devoted his attention almost exclusively to rice, his position being practically that of a crop specialist. Although the major part of the work on cotton in the Presidency has been done—and done extremely well—by Deputy Directors, we consider it desirable that a second Economic Botanist should be appointed whose principal work should be on cotton. His first duty should be to carry out the survey of the Coconada tract which we have proposed above and he should also take up the experiments in crossing between Cambodia and Bourbon to which reference has been made. He should also render all the advice and assistance possible to Deputy Directors in the selection work that is being carried on in the different circles.

153. Our recommendations and conclusions in this chapter may be
Summary. summarized as follows :—

In regard to botanical work :—

- (1) The work on "Western" cotton should continue on its present lines, efforts being made to evolve an improved type on black soils and to discover a type which can suc-

cessfully compete with *roseum* and other *neglectums* on red soils.

- (2) The work on "Northerns" should also continue on its present lines, efforts being made to bring the ginning percentage of the selection known as No. 14 up to 27 in order to enable it to be substituted for the local variety.
- (3) In the case of *karunganni* cotton, the object should be to isolate a type intermediate between Company No. 2 and Company No. 3.
- (4) A thorough survey of the Coconada tract should be taken up, as a preliminary to selection work on this variety on the same lines as are being followed in the "Westerns" and "Northerns" tracts.
- (5) Work on Cambodia should be taken up, the object being to evolve an improved type with a staple of at least an inch in length, and also, if possible, different types for irrigated and unirrigated land.
- (6) No botanical work on *uppani* should be undertaken in view of the fact that this variety is being rapidly displaced by Cambodia and *karunganni*.
- (7) The experiments in crossing Bourbon and Cambodia should be recommenced and carried to definite conclusions but, beyond this, there should be no independent work on Bourbon or *nadam* cottons, as the elimination of these varieties is desirable owing to their propensity to harbour insect and other pests.

In regard to agricultural work :—

- (8) Efforts should be made to discover a suitable leguminous fodder crop for introduction into the rotation with cotton in the "Northerns" and "Westerns" tracts.
- (9) The possibilities of gear and steam ploughing in these tracts should be investigated.
- (10) Efforts should be made to establish open markets in the "Northerns" and "Westerns" tracts with a view to securing an improvement in the methods of picking. Such markets should also be established in the Coimbatore District.
- (11) The question of suitable manures and rotations for Cambodia cotton should be investigated.
- (12) The organization evolved for the distribution of pure seed in the Tinnevely tract should be extended to the other cotton growing tracts, as soon as circumstances permit.

In regard to agricultural staff :—

- (13) Two additional Deputy Directors of Agriculture should be appointed, one for the “Northerns” tract with headquarters at Nandyal and one for work on Cambodia.**
- (14) A second Economic Botanist should be appointed whose first work should be the survey of the Coconada cotton tract and who should also take up crossing work on Cambodia and Bourbon cotton. He should render the Deputy Directors of Agriculture advice and assistance in regard to the selection work carried out in the different circles.**

CHAPTER IX.

Burma.

154. The area of Burma, exclusive of Native States was returned in 1915-16, as 109,004,689 acres. The net area actually cropped during the five years ending 1916-17 averaged only 14,278,000 acres, of which 250,000 acres were under cotton. The percentage of the area under cotton to the total cropped area was 1·8 and to the total area under cotton in India 1·1. It is, therefore, rather in regard to its future possibilities than to the area at present under cotton that Burma is of importance.

Statistical.

155. The important cotton growing districts of Burma are five in number, Thayetmyo, Sagaing, Lower Chindwin, Meiktila and Myingyan. These all fall within what is known as the "dry zone," the rainfall varying from about 25 inches in Myingyan to 37 inches in Thayetmyo. The rainy season commences with the third week in May and ends with the third week in October. The dry zone receives its heaviest rainfall at the beginning and end of the season. July and August are marked by strong steady winds almost devoid of moisture and it is only when these drop that showers occur to any extent. The three months from the middle of November to the middle of February are uniformly cool and pleasant. From the latter date, there is a marked rise in the temperature until shortly after the end of April, when it is sent down by the first showers of the monsoon period. Cotton in Burma is usually grown on poor land, mainly on light upland red soils though, under the influence of high prices, it is spreading to black soils on which, however, wheat is normally more remunerative.

Climate and soil.

156. Except on the borders of the dry and wet zones in the Thayetmyo and Prome districts where the variety known as *Varieties of cotton grown.* *wa-gyi* is grown, and for scattered plants of Cambodia and Caravonica, the only variety of cotton found in the cotton growing tracts of Burma is *Gossypium neglectum*. Of this, there are three strains or subvarieties. *G. N. verum burmanicum*, the ordinary yellow flowered variety, with a lint which is slightly grey in colour, forms by far the greater proportion of the mixture and is known as *wa-gale* : *G. N. roseum avense*, which has a white flower and white lint and is known as *wa-pyu* and *G. N. verum Kokatia*, which has a khaki lint and is known as *wa-ni*, are occasionally found. The latter is regarded as an impurity and a large staff of coolies is employed at the ginning factories to pick it out. Both the staple and the ginning percentage of *wa-gale* vary considerably. The former is from $\frac{4}{8}$ ths to $\frac{9}{8}$ ths inch in length whilst the estimates we received for the ginning percentage varied from 28 to 33 per cent. The *wa-gyi* cotton grown in Thayetmyo and Prome is *G. obtusi*

folium var nanking. It is a yellow flowered variety with white lint, the staple of which is superior to that of *wa-gale*, averaging $\frac{5}{8}$ ths inch, whilst its normal ginning percentage is estimated at 39 to 40. per cent. The word "*wa-gyi*" simply means "big cotton" and it is so-called because the plant is considerably bigger than that of the *wa-gale* variety. In the Northern Shan States, a variety of cotton is grown which has not yet been classified botanically but appears to be an Asiatic type closely related to the *neglectum* varieties. This is stated to be an excellent cotton with a staple of about an inch in length but with a very low ginning percentage. It is not the only variety found in the Shan States for it would appear that a type of American cotton, probably Cambodia, has recently made its appearance in that tract.

157. Cotton in Burma is sown early in May. Picking commences about October and continues until the end of the year or even later in the case of the *wa-gyi*

Cultivation of cotton.

variety. Cultivation is inefficient, most of the implements used being still eminently primitive. Cotton is everywhere sown broadcast though the efforts of the Agricultural Department to introduce the practice of sowing it in lines have met with some success. The usual rotation with cotton is either *juar* or sesamum, though, when it is grown on black soils, it is occasionally rotated with wheat. Manure is seldom applied though village refuse and cattle dung are occasionally thrown on the land and are unevenly spread over it with a harrow. Cotton is never irrigated as the Burman cultivator always prefers to grow rice whenever he can get water.

158. Experiments with exotic cotton in Burma commenced about 1890, when American and Egyptian seed was distributed in Sagaing, Meiktila and Mandalay.

Past work on cotton.

Nothing resulted from these and nothing further was done until 1901-02, when further trials were made both in Upper and Lower Burma. By 1908-09, it had been decided that the climate of Lower Burma was unsuitable for exotics and though extensive experiments were carried out for some years in Upper Burma at Mandalay, the record up to 1911-12 was one of complete failure. Cambodia was introduced in 1912-13 and gave a yield of 1,200 pounds of seed cotton per acre at Tatkon in the Yamethin district but, though this variety has been grown annually at Tatkon since then, the yield has never equalled that of the first year. In 1914, a farm of forty acres in extent was opened at Tatkon which has as its principal object the improvement of the indigenous cotton and the trial of exotic varieties. *Buri*, Broach and Egyptian cotton have been tried there and elsewhere but have all proved failures. More success has been achieved with the indigenous varieties, especially in regard to improvement in the ginning percentage. A white flowered strain of *wa-gale* has been selected which has a ginning percentage of 40 against 33 for the ordinary variety and seed of this strain sufficient for 300 acres has been distributed to cultivators. A strain of *wa-gyi* with a ginning percentage of 45 against a normal percentage of about 40 has also been selected and is being cultivated on a field scale. Attempts have also been made to improve the staple of the indigenous varieties by crossing. Three crosses

have been effected, one of *wa-gale* with Shan States cotton, one of *wa-gyi* with Broach and one of *wa-gale* with *wa-gyi*. The second of these shows some promise but it is as yet too early to speak with confidence in regard to any of them as their characteristics are still unfixed. On the small farm at Padu in the Sagaing district, which is only $3\frac{1}{2}$ acres in extent, selection work has also been done on *wa-gale* with a view to an improvement in the ginning percentage. Four strains have been obtained, the ginning percentage of which is 34 to 38 and these have been given out to co-operative societies in the neighbourhood. Cambodia was grown at Allanmyo in the Thayetmyo district in 1917 and yielded 1,200 pounds of *kapas* per acre on an area of about four acres of abandoned paddy land. Seed sufficient for about 700 acres was distributed in 1918. Cambodia is also showing promise under well irrigation in Shwebo.

159. It will be seen from the facts stated in the preceding paragraph that very little work has so far been done on cotton in Burma. This has been due almost entirely to the fact that cotton is at present a crop of minor importance in Burma and that the staff of the Agricultural Department is too utterly inadequate to the vast area of the Province to permit of much attention being paid to it. The first step which we would recommend is a thorough botanical survey of the cotton tracts of the Province as well as of the Shan States and a classification of the types grown as regards yield and ginning percentage. This should be followed by simple selection work as we are of opinion that work on crossing is not likely to yield definite results for some years. In view of the great variations in the staple and ginning percentage of *wa-gale*, the aim of such work, at the outset, should be the standardization of the quality of the cotton. Work on these lines appears likely to be more productive of immediate results than the much more difficult work on crossing. This might be postponed until a more adequate staff is available, except in the case of the three crosses already mentioned, work on which should be continued. Whilst we consider that the attention of the Department should be mainly directed to the improvement of the indigenous cottons, especially as the greater part of the cotton crop in Burma comes under our definition of long staple, being about $\frac{3}{8}$ ths in length, we are of opinion that the possibilities of American varieties, particularly Cambodia, should be thoroughly investigated. The prospects of such varieties both in districts such as Prome and Thayetmyo, where the rainfall is well distributed and the soil open, and under well irrigation in districts such as Lower Chindwin and Shwebo appear favourable but it is obvious that no definite opinion on the point can be given until thorough and exhaustive trials have been carried out. We would mention that the climatic conditions of Lower Burma as well as the preference of the cultivator for rice, wherever water is available, make it hopeless to expect any extension of the area under cotton in that part of the Province. For the *wa-gale* tract we would strongly recommend the immediate establishment of a large farm in the Meiktila or Myingyan district which would be near the ginning factories and also in a part of Burma where co-operation is perhaps more highly organized than it is

elsewhere. Such a farm should be equipped with a few gins and an oil engine. As regards the *wa-gyi* tract, we consider it will be sufficient if the Allanmyo farm is equipped with an outfit of three or four gins. We would also recommend the establishment of a farm for testing the possibilities of cotton under well irrigation. A suitable locality for this would be Monywa in the Lower Chindwin district.

160. There is obviously a wide scope for the introduction of improved implements and of improved methods of cultivation as soon as increased staff becomes available. No organization has yet been evolved for the distribution of pure seed though a beginning has been made in this direction at Padu, where, as already stated, the seed of the selected strains is being grown by co-operative societies. At present, there is nothing remotely resembling cotton markets in Burma. The cotton is bought direct from the cultivators in their villages by brokers who travel through the cotton growing tracts. The greater part of the crop is ginned and pressed at Myingyan but there are also factories at Allanmyo and Thayetmyo and in the Meiktila district. The cotton is sent from these factories to Rangoon, from where it is exported to Japan and Europe. If the Agricultural Department succeeds in evolving strains which are superior to the local varieties in staple as well as in ginning percentage, the question of improving the present methods of marketing in order to enable the cultivator to obtain the full value for his cotton will assume great importance and we would invite attention to our general recommendations in Chapter XVI on this point. Even in present conditions, we think that an improvement in the method of marketing might result in an increase in the area under cotton and would suggest that attention should be paid to this point and that efforts might be made to form co-operative sale societies. But we recognize that no rapid progress can be expected in any of the directions mentioned in this paragraph until the staff of the Agricultural Department is strengthened.

161. Burma is at present divided into two circles, the Northern and the Southern, each of which is in charge of a Deputy Director of Agriculture. A third Deputy Director has been recently sanctioned and the post will be filled as soon as an officer can be recruited for it. The staff at present is therefore very small indeed compared with the area of the Province, which is very much larger than that of any other Province in India. Whilst it will be evident from what has been said in the preceding paragraphs that a material increase in the superior and inferior staff of the Agricultural Department is essential to the development of work on cotton in Burma, we do not feel justified in making recommendations for an increase specifically for such work in view of the minor importance of the cotton crop and the fact that the areas in which it is grown are scattered over such a vast tract of country. We feel that the conditions in Burma are such that an increase of staff is much more urgently required for the general agricultural development

of the country than for work on cotton. We understand that proposals have recently been submitted by the Director of Agriculture for the appointment of a Deputy Director of Agriculture for each Commissioner's Division or eight Deputy Directors in all and for the appointment of an Agricultural Assistant for every two districts. Whilst it would be going somewhat beyond our province to accord our support to these proposals, we would point out that they will, if sanctioned, enable the cotton problems of the province, including the Shan States, which up till the present have been practically untouched by the Agricultural Department, to be thoroughly investigated. The prospects of cotton in Upper Burma and the Shan States are, in our opinion, sufficiently hopeful to justify no small part of the energies of the strengthened Agricultural Department being devoted to that crop. In this connexion, we would mention that we were informed that the time of the subordinate staff of the Department is largely occupied with crop cutting experiments in connexion with forecasts. As we have stated in Chapter XVI, we are unable to understand the objects of these experiments as we were also informed that the forecasts are based on data collected by Settlement Officers. We are therefore, of opinion, that the Agricultural Department should be relieved of this work and should confine itself to more legitimate functions.

The cadre of the Agricultural Department in Burma includes a post of the Economic Botanist but this appointment has not yet been filled. We are strongly of opinion that a botanist should be appointed to the Province at an early date and that one of his duties should be to undertake the survey of the cotton tracts which we have recommended in paragraph 159.

162. Our recommendations and conclusions in this chapter may be summarized as follows :—

In regard to botanical work :—

- (1) The first step should be a botanical survey of the cotton growing tracts and a classification of the types grown as regards yield and ginning percentage.
- (2) Simple selection work should then be undertaken, the main object of which should be the standardization of the quality of the cotton.
- (3) Work on crossing should be postponed till a more adequate staff becomes available except in the case of the crosses already effected.
- (4) The possibilities of American cotton, particularly of Cambodia should be thoroughly tested.
- (5) A large farm should be immediately established in the Meiktila or Myingyan district for work on *wi-gale*. Another should be established at Monywa in the Lower Chindwin District which should be mainly utilized for experiments with cotton under well irrigation. To permit of work on *wa-gyi*,

the Allanmyo farm should be equipped with a small ginning outfit.

In regard to agricultural work :—

- (6) As soon as adequate staff becomes available, special efforts should be made to promote the introduction of improved implements and improved methods of cultivation, the evolution of an organization for the distribution of pure seed and the improvement of the present system of marketing.**

In regard to agricultural staff :—

- (7) A large increase in the superior and inferior staff of the Agricultural Department is urgently required for the general agricultural development of the Province. The strengthened staff should devote special attention to work on cotton.**
- (8) An Economic Botanist should be appointed to the Province at an early date, one of whose duties should be to undertake a botanical survey of the cotton growing tracts.**

CHAPTER X.

Bengal, Bihar and Orissa and Assam.

163. In view of the very small importance of the cotton crop in the three Provinces of Bengal, Bihar and Orissa and Assam and of the close administrative connexion between them in the past, we propose to treat them together and do not consider it necessary to enter into such detail as we have done in the case of other Provinces. The average area under cotton in Bengal for the five years ending 1916-17 was 48,000 acres and in Bihar and Orissa, 73,000 acres, forming 0·2 and 0·3 per cent. respectively both of the net cropped area and of the total area under cotton in India. In addition, the Native States of Bengal returned an average area of 22,000 acres under cotton for the five years ending 1916-17. In Assam, the average area was 34,000 acres, forming 0·6 per cent. of the total cropped area and 0·2 per cent. of the total area under cotton in India.

164. The only two districts in Bihar proper, in which the area under cotton is over 10,000 acres, are Saran and the Santhal Parganas. The averages for these two districts are 15,800 and 13,200 acres respectively. As the result of the work described in the following paragraph, American cotton (*G. hirsutum*) is found to a small extent in the Santhal Parganas but the variety of cotton mainly grown in Bihar is *Gossypium intermedium* which is yellow flowered, though white flowered forms are occasionally found. Its long growing season is an obstacle to its popularity and it is mainly grown only for domestic purposes. The staple is from $\frac{5}{8}$ ths inch to $\frac{6}{8}$ ths inch in length, whilst the ginning percentage varies from 15 to 30. The average is probably not more than 17 per cent. which is lower than that of any other cotton in India. The area under cotton in Orissa is insignificant, there being no district which returns as much as 5,000 acres. The cotton consists of the same mixture of *neglectum* varieties as is found in the Central Provinces and need not be further described. The Chota Nagpur Division, in which Ranchi is the most important cotton growing district with an average area of about 15,000 acres, is the original home in India of the acclimatized variety of Upland Georgian known as *buri*, the staple of which is $\frac{7}{8}$ ths to 1 inch and the ginning percentage 31. The *deshi* cotton is of the same type as that grown in Orissa. In Bengal, with the exception of small areas of *neglectum* cotton in Bankura and Midnapore, the whole of the cotton crop is grown in the Chittagong Hill Tracts. Both there and throughout Assam, in which the principal cotton tracts are the

Garó and the Lushai Hills, the cotton, which passes under the name of "Comillas," is the variety known as *G. cernuum* of which there is a subvariety *G. cernuum sylhetense* which has a khaki coloured lint. The staple of Comilla cotton is very short, being only $\frac{3}{8}$ ths to $\frac{4}{8}$ ths inch in length. It is distinguished from other Indian cottons by the size of its bolls, which, in parts of the Garó Hills, attain a length of eight inches and by its high ginning percentage which averages about 43 and, in some cases, goes up to 50. The lint of this cotton is so harsh in character that it is most commonly used as an adulterant with wool and its price is said to be regulated by the price of wool rather than by that of cotton.

165. The *buri* variety, the chief interest of which lies in the attempts which have been made to spread it in the Central Provinces, is said to have been grown in Chota Nagpur for about a hundred years, but there is nothing on record to show by whom it was introduced. The earliest experiment with exotics in other parts of the Provinces was made by Lady Hastings near Barrackpore in 1823 with seed obtained from the Barbadoes. In 1844, one of the American planters, to whom reference has been made in previous chapters, started a plantation at Rangpur on which American and Bundelkhand cotton was grown but the experiment was not long persisted with. Isolated trials both of exotic and Indian varieties were subsequently carried out at various places by officials and non-officials, notably by the Agri-Horticultural Society of India in its gardens at Alipore, but the results obtained were, in almost every case, unsatisfactory and led to nothing. It was not until the re-organization of the Agricultural Department at the beginning of this century that the question was attacked with some vigour. The seed of various American, Egyptian and Indian varieties was distributed all over the three Provinces, but by 1905-06 the Department of Agriculture in Bengal, which then included Bihar and Orissa, had decided that if anything was to be done towards the improvement of the cultivation of cotton in that Province it would be best to work on the indigenous or already acclimatized varieties. A systematic attempt was therefore made for a few years to promote the cultivation of *buri* in certain areas in the Singhbhum and Santhal Parganas Districts but so little progress was made that it was abandoned on the redistribution of the Provinces in 1911. *Buri* and Cambodia were also tried in Assam but, although the results obtained by the Kamalpur Estates, Limited, were considered promising in 1912, the experiment was subsequently given up as unprofitable. It was not until 1917 that work on cotton was resumed in any of the Provinces. In that year, Mr. A. C. Dobbs, Deputy Director of Agriculture, commenced a series of experiments with *buri* and with several selected American varieties from Cawnpore and Lyallpur on the Ranchi farm on the Chota Nagpur plateau at an elevation of 2,000 feet. It should be mentioned that the cotton of the plateau is *deshi*, *buri* being grown at lower elevations. All the cottons tried at Ranchi suffered severely from heavy rain but four of the Cawnpore selections gave better yields than any of the *deshi* varieties. Both *buri* and 4F proved complete

failures. We understand that it is proposed to open a small farm at an elevation of about 1,000 feet mainly for the purpose of further trials with cotton.

166. We consider that sufficient work has been done on cotton in these Provinces, except perhaps in Chota Nagpur, to show that exotic varieties of cotton are unsuited to their climatic and other conditions and see no prospect of any appreciable extension of the area under the indigenous varieties. We would, however, recommend that the work at Ranchi should continue on its present lines and are glad to observe that special attention is being paid to selection work on the American varieties. We also recommend that the botanical survey of the cotton tracts of the Provinces, which was commenced by Mr. Gammie and is being continued in Bihar and Orissa by Mr. Dobbs, should be completed as this is likely to lead to the collection of valuable information. We are of opinion, that, as soon as time and opportunity permit, the Agricultural Department in Bengal and Assam should take up selection work on Comilla cotton, with a view to obtaining an improvement in and the standardization of the ginning percentage of this variety, which is at present extremely variable. Some improvement in staple might also be effected by work of this character. We are aware that Comilla cotton is mainly grown by primitive peoples but there appears no reason to believe that they would not take readily to any improved strains put out by the Agricultural Department.

Recommendations in regard to future work on cotton.

167. Our recommendations in this chapter may be summarized as follows :—

- Summary.*
- (1) The experiments with *huri* and selected American varieties in Chota Nagpur should continue on their present lines.
 - (2) The botanical survey of the cotton tracts in the three provinces should be completed.
 - (3) Selection work on the Comilla variety should be undertaken with a view to the improvement and standardization of its ginning percentage and, possibly also, of its staple.

CHAPTER XI.

Hyderabad.

168. Complete agricultural statistics for the Hyderabad State are not available. The area under cotton for the five years ending 1916-17 averaged 3,262,000 acres forming 14·7 of the total area under cotton in India, including Native States. The only parts of India which return a greater area and percentage are Bombay and the Central Provinces and Berar.

169. The Hyderabad State falls into two well marked and nearly equal divisions, if a line is drawn due north and south through the Capital city of Hyderabad. The area east of that line is known as Telingana and that to the west as Mahratwarra and the Canarese country. In the Mahratwarra districts and the Canarese country, the climate is generally hot and dry from March till the end of May and temperate for the remaining months. In the Telingana districts, it is hot and damp from March till the end of September and temperate for the rest of the year. The rainfall varies from about 25 inches in the south-west to 50 inches in the north-east. Over three quarters of it is received between June and September, the remainder practically all falling in October and November. The soil of the cotton growing tracts is mainly the black cotton soil found in the adjoining tracts in British territory but in the Telingana Districts it is not so rich as in the north and cotton is frequently grown on lighter sandy soils.

170. No botanical survey of the cotton grown in Hyderabad has been carried out and whilst fairly full information is available in regard to the varieties grown, it is impossible to speak with certainty regarding the proportion in which they are found. All over the north of the Province and as far south as Gulbarga, the cotton grown, which passes under the trade name of "Barsi and Nagar," is mainly a mixture of the same varieties as in the Central Provinces and Berar except that *bani* (*G. indicum*) is found in a much higher proportion and that *buri* (*G. hirsutum*) is said to take the place of Upland Georgian. We are informed that in the north-eastern portion of the tract, i.e., in the Adilabad, Nizamabad and Karimnagar districts, *buri* predominates and is grown pure over large areas. It would appear to be shorter in staple here than elsewhere. We are inclined to think that it is the same variety as the Upland Georgian of the Central Provinces but, as no botanical survey of the cotton of Hyderabad has been carried out, are unable to express a definite opinion on the point. Further west, mainly as the result of the recent efforts of the Agricultural Department, which are described below,

bani is grown in a pure state over large parts of the Parbhani and Nander districts, whilst round Jalna in the Aurangabad district and in the Osmanabad district and the northern part of the Gulbarga district, it forms a high proportion of the mixture. This variety was formerly the true cotton of the Mahrattwarra country but so rapid was its deterioration owing to the admixture of Berar seed, that, had not the Agricultural Department taken up the question of restoring it to something like its former standard, its disappearance, except in a few tracts away from the railway or as an unimportant constituent of a mixture of varieties, would, in all probability, have been a matter of a few years. The *bani* cotton of Hyderabad has now been given a separate classification by the cotton trade and is known as Hyderabad *gaorani*. Its staple is about an inch in length and the ginning percentage 29. In the southern districts of Hyderabad, cotton is only grown in the extreme west and east. The cotton of the Raichur district and the south of the Gulbarga district is the "Westerns" cotton of the adjacent Madras tract, whilst in the south-east of the Warangal district there is a considerable area under the Coconada variety. The cultivation of Cambodia is now being introduced in the neighbourhood of Chincholi in the Gulbarga district. A full description of the different varieties of cotton grown in Hyderabad will be found in the chapters on the British Provinces which adjoin the State and need not be repeated here. This also applies to the methods of cultivation which are similar in Hyderabad to those followed in the adjacent British districts.

171. No botanical work on cotton has hitherto been done in Hyderabad and the energies of the Agricultural Department in regard to cotton have been mainly devoted to efforts to restore *bani* to its former purity. These have met with considerable success and we were informed that the Department had purchased and proposed to distribute sufficient seed for sowing at least 260,000 acres in the season of 1918, as a result of which nothing but this variety would be grown in three *taluks* in the Parbhani district. It is estimated that the distribution of pure seed of the *bani* variety has increased the ginning percentage to 29, as against the previous average of 25 to 26. The Department has two cotton farms, one at Parbhani for work on *bani* and the other at Mahbubnagar in the district of that name for work on Cambodia. We would mention that the Hyderabad State has already taken action in regard to two of the malpractices mentioned in Chapter XVI. Damping has recently been made a penal offence whilst in order to stop the practice of transporting cotton by rail to a station which is not its ultimate destination, with the object of inducing the purchaser to believe that it is the produce of the latter, it has been enacted that bales should be stamped with indelible ink so that unless they are opened out and repacked, they still retain the mark of their place of origin.

172. It will, we think, be seen that there is a very wide field of work before the Agricultural Department in Hyderabad in regard to cotton. We feel that the cotton problems of the State cannot be ade-

Recommendations in regard to future work on cotton.

quately dealt with until the staff of the Department has been considerably increased and have made recommendations on this point in the following paragraph. We consider it most important that a thorough botanical survey of the cotton tracts should be carried out as soon as sufficient staff becomes available. The Agricultural Department will then be in a position to decide upon a definite policy for each of the main cotton growing tracts. In the absence of staff, the Department naturally turned to the work which lay nearest at hand, the restoration of *bani* to its former standard. Whilst we cannot but regard any efforts to promote the cultivation of long staple cotton in India with the greatest sympathy, we feel bound to point out that the primary consideration must be the interests of the cultivator. It has not yet, in our opinion, been definitely established that *bani* is the most profitable variety from the cultivator's point of view in the conditions which prevail in the north of Hyderabad. We trust that, as the result of our recommendations as a whole, it will be easier for the cultivator to obtain the full value of long staple cotton than it has been in the past. If this proves to be the case, the work which has been done to preserve the *bani* variety in Hyderabad will have been of the greatest value. But whilst we would recommend that it should continue for the present, we are strongly of opinion that, either simultaneously with or on the completion of the botanical survey we have proposed, exhaustive tests should be carried out in order that a definite conclusion may be reached in regard to the merits of *bani* as compared with other varieties. Should such tests establish the superiority of *bani*, the Agricultural Department will be able to continue its work in spreading that variety with all the greater confidence. We would also recommend that further tests should be carried out with Cambodia before seed is given out on a large scale. We would suggest that selection work on *bani* should be undertaken as soon as possible on the lines we have proposed in British Provinces with a view to obtaining further improvement both in staple and ginning percentage. We consider that selection work on other varieties is of less importance in present conditions. The botanical survey and the tests we have proposed above should shew on what varieties such work can be most advantageously undertaken. It is, in our opinion, eminently desirable that any botanical work done in Hyderabad should be carried out in close co-operation with the specialists working on the same problems in the adjacent British Provinces and we would strongly recommend that if His Exalted Highness the Nizam's Government desires any advice or assistance from scientific officers in British service, whether Imperial or Provincial, in regard to work on cotton, it should be freely given.

173. The superior staff of the Agricultural Department in Hyderabad at present consists only of a Director of Agriculture. We would suggest for the consideration of the Darbar the desirability of a considerable addition to the staff not only for work on cotton but in the interests of general agricultural development. We would recommend the appointment of two Deputy Directors of Agriculture,

**Recommendations in regard
to staff.**

one for the Mahratwarra and the other for the Telingana country, whose main work should be on cotton. Even after such a division, the former will be a heavy charge on account of the mixed character of the cotton grown in it and further sub-division will eventually be desirable. We would also suggest the appointment of an Economic Botanist whose work on cotton would be on the lines proposed in the preceding paragraph.

174. Our recommendations in this chapter may be summarized as *Summary.* follows :—

- (1) A botanical survey of the cotton tracts should be carried out in order that the Agricultural Department should be in a position to decide on a definite policy for each tract.
- (2) Simultaneously with, or subsequent to such a survey, exhaustive tests should be carried out in order that the comparative merits of *bani* and other varieties may be authoritatively ascertained.
- (3) Further tests should be carried out with Cambodia before the seed of this variety is given out on a large scale.
- (4) Botanical work on *bani* on the lines proposed for British Provinces should be commenced as soon as possible and should be followed by similar work on other varieties.
- (5) Botanical work should be carried out in close co-operation with the specialists working in British Provinces and if His Exalted Highness the Nizam's Government desires it, such officers should freely render advice and assistance.
- (6) The superior staff of the Agricultural Department should be increased by the appointment of two Deputy Directors, one for the Mahratwarra and the other for the Telingana country, and of an Economic Botanist and the main work of these officers should be on cotton.

CHAPTER XII.

Baroda.

175. Complete agricultural statistics for the Baroda State are not available. The average area under cotton for the five years ending 1916-17 was 725,000 acres or 3·2 per cent, of the total area under cotton in India. It is estimated that the percentage of cotton to the total cropped area is about 24, a figure which is exceeded in no other Native State or in any British Province in India, taken as a whole.

176. The territory of the Baroda State consists of scattered tracts in Gujarat and Kathiawar. As has already been mentioned in the chapter on Bombay, these are so intermingled with British Districts that it is impossible to treat the State entirely as a separate unit for our present purpose. Of the four districts into which it is divided, three, Kadi, Baroda, and Navsari, are in Gujarat whilst the fourth, Amreli, is in Kathiawar. The climate and soil of these districts is similar to that of the adjacent British territory and need not therefore be further described. The varieties of cotton grown in them are also the same, Kadi and Amreli falling into the "Dholleras" tract and Baroda and Navsari into the Broach tract. A full description of these has already been given in the chapter on Bombay and it is only necessary to add a few details in regard to their distribution in the Baroda State. The mixture of varieties of *Gossypium neglectum* known as *mathio* is the only cotton grown in the Amreli District, except in the Kodinar *taluka* where some Upland Georgian is found in it. In the Kadi District, *wagad* is grown in the heavy soils of the Kadi, Kalol and Chanasma *talukas*. In the remainder of the district, *lulio* is preferred and is usually grown as an irrigated crop. In the black soil or *kanam* tract of the Baroda District, which includes the Sinor, Dabhoi, Karjon, Saoli and Waghoda *talukas*, the cotton grown is the mixture of Broach and *goghari* known as *kanvi*. On the light soils of the Bhadran and Petlad *talukas* of the Kadi District, the perennial variety *rozi* (*G. obtusifolium*) is grown mixed with *kodra* (*Paspalum scrobiculatum*) but is unimportant. In the Navsari District, the Navsari tract extends from Bilimora to Sachin, the Surat tract commencing at Sachin and extending to Kosamba. The spread of *goghari* in recent years, owing to its higher outturn and ginning percentage, has been as rapid in the southern districts of the Baroda State as in British territory.

177. The superior staff of the Baroda Agricultural Department consists of a Director of Agriculture and a Deputy Director. The Department has at

present three farms at Baroda, Jagudan (north of Ahmadabad) and Dwarka. The latter is being closed on account of irrigation difficulties but additional farms will shortly be opened in the Navsari and Amreli Districts. Experiments with exotics, more especially *buri*, Cambodia and various varieties of Upland American, have been carried out on the Baroda and Jagudan farms since 1909-10 but have proved no more successful than in British Gujarat. In 1914-15, an attempt was made to introduce Cambodia into the Kadi District. The yields obtained were moderately good but considerable difficulty was experienced in disposing of the small quantity of cotton produced and the cultivators therefore went back to the indigenous varieties. Some work on *mathio* and *lalio* has been done on the Baroda and Jagudan farms but has not yet led to any definite results. In 1916-17, sufficient seed of pure Navsari cotton for 1,000 acres was selected by mass selection, and distributed by the Agricultural Department. We understand, however, that the cultivators did not realize any more for the cotton produced from this seed than for the ordinary *kanvi* mixture and that attempts to extend the area under such seed have been abandoned.

178. The recommendations we have made in regard to the Dholeras and Broach tracts of the Bombay Presidency
Recommendations in regard to future policy. apply with equal force to the Baroda State and it does not appear necessary to supplement them except in a few respects. We do not recommend that any further attempts should be made to introduce exotics in Baroda. In those parts of the State, in which the climate and rainfall are suitable, indigenous varieties which fall under our definition of long staple cotton are already grown. We are therefore strongly of opinion that the Agricultural Department in Baroda should confine its attention to the improvement of the indigenous varieties and the production of good seed for distribution on the lines we have laid down for the adjacent tracts in Bombay. We understand that the Bombay and Baroda Agricultural Departments work in close co-operation and we do not therefore consider that any immediate addition to the superior staff of the Baroda Agricultural Department is called for. We would, however, point out that the organization of the production and distribution of good seed will necessitate an increase in the subordinate staff and would suggest the appointment of additional officers of the class of Agricultural Assistant for this purpose. We have recommended that a botanist should be appointed for the Dholeras and Broach tract of the Bombay Presidency and we have no doubt that the results of this work will be freely placed at the disposal of the Baroda Agricultural Department. We are of opinion that the line of work in which the latter Department can at present most usefully co-operate with the Bombay Agricultural Department is the investigation of the relative values of the constituents of the Dholeras mixture. We would also recommend, as we have done in the case of Bombay, that efforts should be made to maintain the purity of *wagad* in the Kadi District and to restore *lalio* to its former standard in that district. If, in the Broach *deshi* tract, the Bombay Agricultural Department succeeds in evolving

a type of Broach cotton superior to *goghari* in yield or ginning percentage or, in the Surat tract, a strain equal, if not superior to the best Navsari cotton, the Baroda Department will doubtless co-operate in promoting the cultivation of such strains in the adjacent territories of the State. It is, in our opinion, essential that the same strains should be given out by the two Agricultural Departments and to secure uniformity of policy in this respect and the fullest measure of co-operation possible, we would recommend periodical conferences between the officers of the two Departments. It is to be regretted that the recent efforts to promote the cultivation of pure Navsari cotton have proved a failure. We think these might have been more successful, had there been some organization for the disposal of the cotton produced and would invite attention to our recommendations on the subject of organization in the chapter on Bombay. We would suggest that further efforts should be made in this direction and that the possibility of holding auction sales of the *kapas* produced should be considered.

179. We should perhaps mention that we were informed that some canal projects are under investigation in the Baroda State and that, if these were carried out, a considerable increase in the area under cotton might be expected. The information placed at our disposal was not, however, sufficiently definite to enable us to express any opinion on this point.

180. Our recommendations in this chapter may be summarized as follows :—

- (1) No further efforts should be made to introduce exotics in the Baroda State but the efforts of the Agricultural Department should be confined to the improvement of the indigenous varieties and the production of good seed for distribution.
- (2) In order to build up an organization for the production and distribution of good seed, the subordinate staff of the Agricultural Department should be increased by the appointment of additional officers of the class of Agricultural Assistant.
- (3) The Agricultural Department should devote itself more particularly to work on the Dholleras mixture and should make special efforts to maintain the purity of *wagad* and to restore *labio* to its former standard in the Kadi District.
- (4) All work on cotton in Baroda should be carried out in close co-operation with the Bombay Agricultural Department, periodical conferences being held between the officers of the two Departments.
- (5) The organization for the spread either of pure varieties or of improved types should follow the lines proposed for the adjacent tracts in the Bombay Presidency.

CHAPTER XIII.

Central India.

181. For the five years ending 1916-17, the area under cotton in the Native States which make up the Central

Statistical.

India Agency averaged 1,335,000 acres or six per cent. of the total area under cotton in India. Of this, Indore contributed about 450,000 acres, Gwalior 380,000 acres and Bhopal 73,000 acres. It is estimated that the net cropped area of the Agency amounts to about thirteen million acres of which the area under cotton is, therefore, about 10 per cent. In Indore it is as high as 23·6 per cent. of the net cropped area and in Gwalior 9·31 per cent. These figures show that Central India is one of the most important cotton growing tracts in India.

182. The main cotton growing tract of the Agency is the southern part of the western of the two detached areas

Climate and soil.

of which it is composed. This again consists of two natural divisions, by far the larger of which lies on the Malwa plateau. The smaller, known as the Nimar tract, lies south of Malwa proper below the Vindhyan range. The average rainfall of the cotton tract averages about thirty inches, almost all of which is received from the south-west monsoon. The main soil of the plateau is the black soil formed by the disintegration of the Deccan trap. In the Nimar tract, except actually in the bed of the river Narbada, there is a preponderance of the lighter soils which makes irrigation necessary while the stiffer texture of the soil necessitates the use of heavier implements.

183. The main cotton of Central India is the same mixture of varie-

Varieties of cotton grown.

ties of *Gossypium neglectum* with a small proportion of *bani* (*G. indicum*) and Upland Georgian (*G. hirsutum*), here known as *marwari* or *bani*, as is found in the Central Provinces and Berar. These have already been fully described in the chapter on those Provinces. In the Nimar tract, the mixture differs in no way from that grown in the Central Provinces and Berar, but on the plateau, the proportion of *G. neglectum malvense* is high. This variety, which is probably the indigenous cotton of the plateau, from which it derives its name, is an excellent cotton with a staple of $\frac{5}{8}$ ths to $\frac{7}{8}$ ths inch which brings it under our definition of long staple cotton. Its ginning percentage is, however, only 25, a fact which is sufficient to account for the way in which the other varieties of *neglectum*, more especially *roseum*, have gained at its expense in recent years. We estimate that it is not now grown in a pure state on more than 112,000 acres and the evidence we received shows that very little of it comes on the market except in an adulterated condition.

184. The keen interest displayed by the rulers of many of the States in Central India in the agricultural development of their territories led in 1916 to the appointment of Mr. B. Coventry, C.I.E., as Joint Agricultural Adviser to the States of Gwalior, Indore, Bhopal, Dhar, Datia, Ratlam, Jaora, Sitamau, Dewas (Senior Branch) and Sailana and the Estate of Bagli which represent about half the area of the Agency. Since Mr. Coventry's appointment, special attention has been paid to problems connected with cotton and a large part of the work on the experimental farms which have been established at Indore and Bhopal has been on this crop. Experiments with exotics of various kinds and with Mr. Leake's improved varieties K-7 and K-22 have been carried out but have not proceeded long enough to enable any definite conclusions to be reached in regard to them, more especially as the conditions in 1916 and 1917 were most unfavourable to all varieties of cotton. In 1916, K-22, however, showed promise and considerable success was achieved in 1917 in isolating the Upland Georgian variety and in growing it under irrigation on lands on which poppy was formerly cultivated. Cambodia under similar treatment has also been moderately successful, the sub-tropical climate of the plateau appearing to favour the growth of American varieties. It should be mentioned that the Gwalior State has already enforced a system of licensing ginning factories which, though its primary object is fiscal, secures the submission of full statistics of the cotton ginned and could, without difficulty, be extended to such purposes as the prevention of malpractices. A system is also in force in the Gwalior State under which bales of cotton produced in the neighbourhood of Ujjain are stamped as such, inferior cotton brought into Ujjain from other tracts for re-export to Bombay or elsewhere as Ujjain cotton being stamped as "Ujjain mixed." The name of the factory at which the cotton has been pressed is also stamped on the bales in both cases.

185. We see no objection to the continuance of the experiments with exotics in Central India and, indeed, consider it desirable that the suitability of Cambodia or of some type of Upland Georgian for irrigated soils should be thoroughly tested. We would also recommend that further careful comparative trials of Mr. Leake's improved varieties should be carried out. We would, however, point out that the difficulty of evolving a suitable organization for marketing small quantities of improved cottons is likely to be more severely felt in Central India than elsewhere owing to the way in which the territories of the different States are intermingled and the small extent of many of them. In these circumstances, we are strongly of opinion that the most hopeful line of work in Central India lies in efforts to improve the long staple cotton, *malvense*, which the tract already produces and to ensure that the crop is placed on the market in a pure state and is thus able to secure the price which is warranted by its intrinsic merit. At present, as we have already said, the cotton trade only sees it in bulk in an adulterated

condition. It should be possible to secure a considerable improvement in the very low ginning percentage and also in the outturn of this variety by selection work. We need hardly add that this recommendation is based on the fundamental assumption which underlies our report, which is that the general result of our recommendations, if accepted, will be to enable the cultivator to obtain the true premium justified by the superiority of his cotton. We understand that there may be some difficulty in regard to work on *malvense* owing to the fact that the crop was almost totally destroyed by the abnormal rains of 1917 and that therefore very little pure seed is obtainable. Should this difficulty prove insuperable, which we trust will not be the case, we would recommend that the Agricultural Department should concentrate its energies on spreading Upland Georgian or Cambodia on irrigated lands but we consider that further tests in regard to the suitability of these varieties are necessary before seed is given out on a large scale. It will be obvious that, both for the work on *malvense* and American varieties and for the evolution of an organization for ensuring that the produce of superior varieties is marketed in a pure state, a considerable increase of the staff of the Agricultural Department in Central India will be necessary. It is with considerable hesitation that we make any recommendations on this point as we feel that our acquaintance with the circumstances of the individual States is somewhat meagre. We would, however, express the hope that the post of the Joint Agricultural Adviser to the Central India States will become a permanent one. Its value in securing uniformity of policy in such matters as cotton development can hardly be overestimated. We would, therefore, suggest that the position of the Joint Agricultural Adviser should be strengthened and that a farm should be established and placed under his direct control on which he can carry out work for the benefit of all the States. We would mention that the Gwalior State has already a Director of Agriculture who is, however, only a part time officer and that it is under contemplation to appoint two Deputy Directors of Agriculture, one for the northern and the other for the southern division of the State. In Indore, the Director of Agriculture, is also Registrar of Co-operative Societies and in Bhopal, he is also Director of Land Records. The area under cotton in both these States is so extensive that we would suggest for the consideration of the Darbars the desirability of appointing separate Directors of Agriculture. Taking the Agency as a whole, we would recommend an expansion of the experimental work on cotton and also an increase in the subordinate staff of the Agricultural Department. In spite of the importance of Central India as a cotton growing tract, we would not propose the appointment of an Economic Botanist as we consider that the selection work on *malvense* which we have recommended could be carried out under the guidance of the Agricultural Adviser, with the advice and assistance of the scientific officers working in British territory. We understand that Mr. Leake has given considerable help in the botanical work on cotton in Central India and we would recommend that some arrangement of this kind should be continued and that, if necessary, matters might be placed on a more formal footing.

186. The usual practice in Central India is to sow cotton after the first rainfall of the monsoon. The work on the agricultural farm at Bhopal and Ratlam points to the conclusion that cotton sown under irrigation before the monsoon gives a heavier yield. As we have already stated, Upland Georgian and Cambodia have shown some promise under irrigation. In these circumstances, the question of extending irrigation facilities is of some importance. Except in the northern parts of Central India where cotton is comparatively unimportant, flow irrigation from canals is impossible owing to the configuration of the country. As the existing canals are not in the main cotton growing tracts, any extension of the area of cotton under irrigation must be looked for under wells. The attention of the Darbars has already been drawn to the possibilities of well irrigation by Mr. W. H. Moreland, recently Agricultural Adviser to the Indore State, and by Mr. Coventry and we would recommend that a thorough investigation into the subject should be carried out on the lines proposed by them. We would mention that a commencement has already been made in this direction by the formation of Departments of Agricultural Engineering in the Gwalior and Indore States.

187. Our recommendations in this chapter may be summarized as follows :—

- (1) The main line of work on cotton in Central India should be selection work on *malvense* and the evolution of a suitable organization to secure that this variety is marketed in a pure state.
- (2) The experiments with Upland Georgian and Cambodia under irrigation and with Mr. Leake's improved varieties should be continued.
- (3) If work on *malvense* proves impossible owing to difficulty in obtaining pure seed, the Agricultural Department should concentrate its energies on pushing Upland Georgian or Cambodia on irrigated soils provided further tests establish the suitability of those varieties.
- (4) The desirability of making the post of Joint Agricultural Adviser a permanent one and of establishing a large farm on which he can carry out work for the benefit of all States should be considered.
- (5) Separate Directors of Agriculture should be appointed by the Indore and Bhopal States.
- (6) Throughout the Agency there should be an expansion of the experimental work on cotton and an increase in the subordinate staff of the Agricultural Department.
- (7) The advice and assistance of scientific officers working in British territory in regard to botanical work on cotton in Central India should be obtained.
- (8) The possibilities of well irrigation should be thoroughly investigated.

CHAPTER XIV.

Rajputana and Mysore.

188. Time did not permit of our visiting Rajputana and Mysore.

Statistical.

The areas under cotton in these States are, however, by no means insignificant and, in order to render our report complete, it appears desirable to add a few remarks in regard to them. The average area under cotton in Rajputana for the five years ending 1916-17 was 372,000 acres or 1·7 of the total area under cotton in India. This is exclusive of an average area of 45,000 acres in Ajmer-Merwara which represented thirteen per cent. of the net cropped area of that province and ·2 per cent. of the total area under cotton in India. The average area under cotton in Mysore for the same five years was 115,000 acres forming ·5 per cent. of the total area under cotton in India and about ·2 per cent. of the net cropped area of the State.

189. As far as we are aware, no work on cotton has been done in

Rajputana.

any of the Rajputana States. The most important cotton growing tracts in the Agency lie in the east and are adjacent to the cotton growing tracts of the United Provinces and Central India. The cotton grown is a mixture of the same varieties as are found in the United Provinces. We understand that, except in Ajmer-Merwara, it is entirely hand ginned and is used for hand weaving goods for local consumption. The cotton problems of the rest of India have not therefore assumed the same importance in Rajputana. Work on cotton must await the development of Agricultural Departments in the different States and it would be premature to make any recommendations in regard to the policy which should be followed. We would, however, point out that an essential preliminary to such work must be a botanical survey of the cotton tracts and that when such a survey has been carried out, the different States should decide to which variety the energies of the Agricultural Departments, which will doubtless be formed in due course in their respective territories, should be devoted.

190. Cotton in Mysore is almost entirely confined to the black soil

Mysore.

areas of the Chitaldrug and—to a very much smaller extent—of the Shimoga District. With the exception of a negligible area under Cambodia, the varieties grown in Mysore are those of the adjacent districts of Bombay, viz., *kumpla* (*Gossypium herbaceum*) and Dharwar American. Systematic work on cotton was commenced by the Agricultural Department about two years ago when a cotton farm was established. Selection work on

kumpta has been undertaken with a view to obtaining an improvement both in yield and quality and it is proposed to commence similar work on the Dharwar-American variety. As regards future work on cotton in Mysore, we would strongly recommend close co-operation with the Bombay Agricultural Department and would invite attention to our recommendations for the Kumpta-Dharwar tract of the Bombay Presidency. Improved strains either of *kumpta* or of the Upland type of Dharwar-American found suitable in that tract should prove equally suited to the conditions of the adjacent tracts in Mysore. We would also recommend that further tests in regard to the possibilities of Cambodia cotton under irrigation should be carried out though we understand that the area in which irrigation is possible is very limited. We understand that the practice of mixing Dharwar-American cotton with *deski* cotton in ginning factories is prevalent to some extent in Mysore and would therefore draw attention to the recommendations we have made in Chapter XVI on this and kindred matters.

191. Our recommendations and conclusions in this chapter may be
Summary. summarized as follows :—

- (1) Work on cotton in Rajputana must await the development of Agricultural Departments in the different States. A botanical survey of the cotton growing tracts is an essential preliminary to such work.
- (2) Work on cotton in Mysore should be carried out in close co-operation with the Bombay Agricultural Department as the problems are similar to those arising in the adjacent tracts of the Bombay Presidency.
- (3) Further experiments with Cambodia on irrigated soils should be carried out in Mysore.

CHAPTER XV.

General recommendations in regard to agricultural work on cotton.

192. In the previous chapters, we have described in detail the local conditions in each Province in which cotton is a crop of any importance or possesses any possibilities and have made recommendations based on a study of those conditions. We would emphasize that our proposals have been framed in the light of existing circumstances. The policy we have recommended has not, perhaps, in all cases been that which we should have suggested had there been a clean slate on which to work but we have not felt justified in proposing the abandonment of work which has resulted in substantial progress or which still holds out any prospect of ultimate success. In this chapter, we propose to discuss briefly some important questions of general applicability to all Provinces and to add a few remarks in regard to the staff required to carry out our recommendations. We would here mention that we were much impressed by the extent and accuracy of the knowledge of cotton problems possessed by agricultural officers. The evidence we received from the Directors of Agriculture and from the officers of the Agricultural Department generally was of the greatest assistance to us and considerably lightened our labours.

193. We have, in several of the chapters on the different provinces, recommended botanical surveys of many of the cotton growing tracts and would again insist on the importance of such surveys. Unless the Agricultural Department possesses a detailed knowledge of the different varieties of cotton grown, it has no solid foundation on which to base its work on cotton. Such surveys are obviously especially necessary in tracts in which a mixture of different varieties of cotton is grown. Work in this direction has already been done in the Punjab, the Central Provinces, Bombay and Madras but, even in those provinces, it has been by no means exhaustive and we consider that it should be definitely recognized as one of the first duties of the Agricultural Department in all provinces. Whether such surveys should be carried out by a Botanist or by a Deputy Director of Agriculture must depend on local conditions and we have recognized this in the recommendations we have made on the subject. Simultaneously or subsequent to the botanical survey, the varieties found on a field scale should be tested in duplicate or triplicate plots in order that it may be ascertained whether any of the types is distinctly superior to the others. If such

a type is then put out by the Agricultural Department, the result is greater uniformity in the crop and its standardization to a large extent

194. It is essential that an investigator, working on cotton, should have before him a clear idea of the staple which the tract is capable of producing in ordinary conditions. Irrigation produces an alteration in the conditions and the cultivation of cotton of longer staple may become feasible. We would lay stress on "selection" as much the most rapid method of securing a type of cotton suitable for a particular tract and of obtaining an improvement in staple and ginning percentage. Plants of pure strain with a higher ginning percentage and a longer staple than the cotton ordinarily grown can usually be isolated in the field. The work of the Madras Agricultural Department on *karunganni* has furnished a striking example of this. The ginning percentage of ordinary *karunganni* is 25 and its staple $\frac{7}{8}$ ths of an inch in length. Plants have, however, been isolated with a ginning percentage of 35 and others with a staple of $1\frac{3}{8}$ ths inch in length. Whilst we consider that selection work should be the first step, we do not underrate the importance of cross breeding as a means of improving cotton. This, however, as has been already pointed out in the chapter on the United Provinces, is work of a more scientific character than selection work and requires close application and considerable skill. It is also much slower in yielding tangible results. We consider, therefore, that, as a general rule, it should not be undertaken until the possibilities of selection work have been thoroughly examined as, unless the material on which it is based has been investigated, it is almost certain to result in disappointment. Reference has already been made to the work on crossing which has been done at Cawnpore and Dharwar, and which has resulted in some promising crosses. We consider that work of this character should be entrusted only to an officer who can devote personal attention and considerable time to it. Whilst it is work that can be done by Deputy Directors with botanical training, it will probably be found advisable to leave it to a botanist. On the whole, except in the cases we have mentioned above, very little progress has been made in this direction, but we consider that there is a great future for work of this character if it is properly and systematically conducted. It is for this reason that we have recommended that Mr. Leake's work at Cawnpore should continue on its present lines and that assistance should be given him in carrying it out.

195. We found that great diversity of practice exists in the different provinces in regard to the tests of cotton on a field scale. In many cases, such tests are carried out on small plots whilst, in others, the plots are an acre in extent. In both cases, there may or may not be duplication. We consider that tests on a field scale should be carried out in at least two series. The first series should consist of preliminary tests on small plots from four cents (one twenty-fifth of an acre) to ten cents (one-tenth of an acre) in size. Tests on plots of four cents repeated two or

three times have been successfully carried out in the "Northern" and "Western" tracts in Madras and, if carefully conducted, should enable a good general idea of the value of the variety tested to be formed. The second series should consist of tests on larger areas. The plots should be at least a quarter of an acre in extent and there should be five or six of such plots side by side with plots on which the same standard variety of cotton is grown. At Lyallpur, tests of this character are carried out on the land of the farm tenants, in order that the closest possible approximation to conditions outside the experimental station may be formed. We consider it most important that tests on a large scale should be carried out under the same conditions as those in which cotton is ordinarily grown before an improved type is given out on an appreciable scale. Definite rotations should be followed on the plots on which the tests are made and as large an area as possible should be allocated for such tests. We are of opinion that there was room for improvement in this respect in all the Provinces we visited but have not thought it necessary to do more than indicate the general lines which should be followed.

196. In the course of our enquiries, contrasts between the two greatest cotton producing countries of the world, India and the United States of America, have constantly thrust themselves upon us.

Improvement in yield of cotton.

In no respect is the contrast more marked than in the relative productivity of the soil. The United States of America produce a crop of twelve to sixteen million bales of 500 pounds each from an area of 36 million acres whilst India, from an area of about $22\frac{1}{2}$ million acres, produces a crop of slightly over $4\frac{1}{2}$ million bales of 400 pounds each or 3,600,000 bales of 500 pounds each. As was mentioned in Chapter I, the yield per acre is only a little over one-third of that obtained in America, being about 85 pounds an acre as against 200 pounds in the United States. As has also been pointed out in the same chapter, the scope for obtaining an increase in outturn merely by an improvement in agricultural practice is therefore considerable. In India, taken as a whole, cotton cannot be regarded as a crop which receives intensive cultivation, especially as compared with such a crop as wheat. It is seldom manured as the manure available is either required for more profitable crops or is insufficient for more than a small fraction of the area under it. We have, in the previous chapters, dealt with the cultivation of cotton in the different provinces in detail and need here only mention that in many tracts such as Gujarat, the Central Provinces and Berar and parts of Madras, the cultivation of cotton is extremely good, as it is sown in lines and given frequent interculture. There is, however, much room for improvement over very large areas in the Punjab, Sind, the United Provinces; and parts of Central India and Madras. Over the bulk of the cotton areas, more especially in Berar, Central India, Bombay, Baroda, Madras and Hyderabad, the percentage of cotton to the cropped area is often as high as fifty and the result is that it is grown at least every alternate year and frequently year after year. In such conditions the great need is suitable rotations. The

most common rotation with cotton in such tracts is *juar* (*Sorghum vulgare*), the advantage of which is that it provides grain for human consumption as well as fodder for cattle. It is most important, in our opinion, that efforts should be made to introduce into the rotation a heavy yielding leguminous fodder crop which can be grown either with or instead of *juar*. The evidence we received pointed to the beneficial influence of nitrogen on cotton in all tracts and this appears the simplest method by which it can be obtained. As we have already pointed out in the chapter on the Central Provinces, a three-year rotation would have the effect of reducing the area under cotton and is not, therefore, likely to prove acceptable to the cultivators in the principal cotton growing tracts owing to the high prices of cotton at present prevailing. It should, however, be pointed out that these prices have introduced a new factor into the situation. They should render it possible for the cultivator to use artificial manures to a much greater extent and to expend more labour on cultivation than has hitherto been the case. Some attempt has been made to push the use of poudrette and crude night-soil as manure in Bombay and there is no doubt that these are excellent manures for cotton. The use of improved implements for interculture and other purposes is a matter to which the Agricultural Departments are paying increased attention. We have made detailed recommendations on all these points in the preceding chapters and have emphasized their importance.

197. It will be seen from the general trend of the recommendations we have made in the provincial chapters that we are of opinion that the selection and distribution of pure seed should be controlled by the Agricultural Department in the manner best suited to the local conditions of each tract. We lay great stress on this point as no real progress in increasing the outturn or in improving the quality of cotton can be expected unless pure seed of high germinating power is issued. We consider, therefore, that one of the first duties of the Agricultural Department after it has been strengthened, as we have recommended, should be the evolution of suitable organizations for seed distribution. For this purpose, a considerable increase in the number of seed farms will be necessary in all provinces. It will be obvious that the establishment of such seed farms must, in many cases, await the evolution of pure or improved strains of cotton but we consider that the subject is one to which immediate attention should be paid, as, in view of the constantly increasing price of land, it may be advisable that steps should be taken at once to select and acquire suitable sites for such farms.

198. We have pointed out in paragraph 196 above that another most important branch of work to which the increased staff of the Agricultural Department must devote its energies is the improvement of agricultural practice. It must demonstrate the usefulness of improved agricultural implements and must convince the cultivators of the advantages resulting from the use of manures and from good cultivation such as sowing in lines.

and keeping the ground clean from weeds. The methods of demonstration must vary according to local conditions, but, in most cases, it will probably be found best to carry out demonstration work on the fields of selected cultivators. The advantage of this system is that successful methods are adopted without hesitation by the neighbouring cultivators. Small cultivators are apt to regard demonstration work on Government farms with suspicion on the ground that it is carried out regardless of expense and to question the suitability of the methods followed on the farms to their conditions. Demonstration on their own lands is free from the suspicion of officialdom. The experiment forms merely an ordinary incident in the agriculture of the village. In some cases, however, where there are large bodies of landholders with extensive holdings it may be found expedient to have separate demonstration farms of considerable size which can serve as model farms. Where such farms are established, they should be run on thoroughly practical business lines, an accurate profit and loss account being maintained in order that the financial results of their working can be definitely ascertained.

199. We consider it desirable to make some mention of work on tree cottons as it has been asserted from time

Tree cottons.

to time that the solution of the problem of growing long staple cotton in India lies in this direction. From 1904 to 1909, experiments with tree cottons were carried out on an extensive scale in Bengal and Bihar and Orissa by the Indian Long Staple Cotton Growing Syndicate and in 1904-05 and the subsequent year, the Bombay Agricultural Department carried out an experiment on a fairly large scale with Peruvian cotton. In both cases, the experiments proved complete failures. For some years, the Bombay Agricultural Department continued to devote considerable attention to work on tree cottons on the Dharwar, Surat and Nadiad farms but it led to no definite results and was eventually abandoned. It was urged before us that the failure of the operations of the Syndicate was due to the fact that the cotton was grown on waterlogged land. This, however, could not have been the case in Bombay. Whilst there is some reason to believe that tree cottons, which undoubtedly produce lint of excellent staple, can be grown successfully on small areas in favourable circumstances, we are strongly of opinion that there is no prospect of such cottons being produced profitably on a commercial scale and consider that it would be a waste of time and involve an undesirable dissipation of energy for the Agricultural Departments to devote any further attention to work on these varieties except to the very limited extent we have recommended in the case of Madras, where there appears some prospect of obtaining a satisfactory cross between a tree cotton and an annual cotton such as Bourbon and Cambodia.

200. The cotton crop in India suffers relatively little from fungus diseases. The most serious of such diseases is

Mycological aspect.

the root disease known as wilt which occurs in an area extending from the Central Provinces and Berar through Khan-

desh to the Kumpta-Dharwar tract in Bombay. It is not found in the Punjab, Sind, North Bombay, Madras or Mysore though it appears probable that it is extending from Dharwar in a southerly direction. There has been a considerable increase in the disease, especially in the Central Provinces and Berar, during the last ten years and hitherto the only methods of checking it have been the adoption of rotations and the growth of resistant varieties. Neither of these methods can be regarded as entirely satisfactory. The obstacles in the way of the adoption of rotations have been described above. The growth of resistant varieties, such as *buri* in the Central Provinces, means that the cotton of the wilt infected area differs from the ordinary variety of the tract and that there is considerable danger of the two being mixed. Another root disease of cotton, which is often confused with wilt, is the root rot found in the Punjab and Bombay. This disease occurs usually on the same patches of land year after year and there is no evidence that it is increasing appreciably. Whilst leaf diseases are comparatively unimportant, the disease known as red leaf blight occasionally occurs and no remedy has so far been found for it. In these circumstances, and more especially in view of the possibility of the spread of wilt, we consider the mycological questions connected with cotton of sufficient importance to justify the appointment of an additional mycologist to the Pusa staff whose principal duty would be the investigation of these problems.

201. We have made recommendations in the preceding chapters which involve a very considerable expansion of the Agricultural Department. We have, however, indicated only what may be considered the minimum staff necessary in present conditions. Our recommendations are, in fact, studiously moderate as we have been compelled to recognize the difficulties which stand in the way of the recruitment of the superior staff and of training the subordinate staff required. We need hardly point out that though we have confined ourselves to proposals for an increase in the superior staff, these involve a corresponding expansion of the subordinate staff of supervisors, fieldmen, etc. We would emphasize the necessity that the staff we have suggested should be appointed without delay. The cotton position calls for immediate action. Time is an essential factor. An increase in the production of cotton throughout the world, especially within the Empire, is of primary importance, if the raw material is to be kept at a reasonable price and cotton is to be sold throughout India at reasonable rates. It must not be forgotten that the price of "Fine Broach," the standard on which the prices of Indian cotton are based, ruled before the war at about Rs. 250 per *khandi*. At the time of writing, it is Rs. 770 per *khandi* and there appears to be considerable likelihood that it will go much higher. The Liverpool price of "Middling American" which, before the war, ruled ordinarily at 6½d. to 7d. per pound is now as high as 25d. per pound. In these circumstances, it is of vital importance that every effort should be made to increase the production of cotton in India in order that prices may be reduced to more normal figures.

202. The recommendations we have made in regard to the staff of the Agricultural Department are summarized in the following table :—

Cost of proposals.

Province.	Directors.	Deputy Directors.	Assistant Directors.	Economic Botanists.	Mycologist and Entomologist.
Imperial	1 Mycologist.
Punjab	3	3 (Provincial service.)	1	..
North-West Frontier Province .	..	1	..	..	..
United Provinces	3	..	1	1 Entomologist.
Central Provinces	1	..
Sind	1	1	..	1	..
Bombay	2	1 (Indian Agricultural service.)	3	..
Madras	2	..	1	..
Burma	1	..
Hyderabad	2	..	1	..
Central India	2	..	..	..	..

As far as British territory is concerned, it will be seen that they involve the immediate addition to the existing staff, and to the appointments which have been sanctioned but not yet filled, of one Director of Agriculture, thirteen Deputy and Assistant Directors of Agriculture belonging to the Indian Agricultural Service, nine Economic Botanists,* one Agricultural Entomologist, and three Assistant Directors belonging to the Provincial Service. In the case of Native States, they involve the appointment of two Directors of Agriculture, two Deputy Directors and one Economic Botanist. We have made no specific proposals for an increase in the subordinate staff of the Agricultural Department as this would have involved an examination into the internal organization of the Department which was beyond our province. We would, however, state that we consider the subordinate staff very inadequate in most provinces and are of opinion that it should be considerably strengthened not only for work on cotton but also in the interests of agricultural development generally. It is impossible to estimate the cost of the proposals with any approach to accuracy as the cost of the subordinate staff, upkeep of farms and other expenditure involved in addition to that on the superior staff varies so greatly in the different provinces. But if Rs. 50,000 be taken as the average cost of a Director, Deputy Director or other scientific officer and his subordinate establishment, etc., in British territory with half as much in Native States, the cost of our proposals works out very roughly at about Rs. 14 lakhs per annum, exclusive of the cost of the Cotton Committee,

* This number includes the appointment of Economic Botanist in Burma which has been sanctioned but not yet filled.

the establishment of which we have recommended in Chapter XIX and for which we consider that an annual grant of at least two lakhs of rupees should be provided.

In the financial year 1916-17, the total expenditure on the Imperial Department of Agriculture was Rs. 5,18,603 and on the Provincial Departments Rs. 47,74,524, a total of Rs. 52,93,127 which is equivalent to £353,000 at the usual rate of exchange or less than £1.5 per 1,000 of the population of British India. In point of fact, the actual cost of the Agricultural Department to the country was less than this, as the sales of produce from the Government farms were not credited to the Department. An addition of some Rs. 16 lakhs to this expenditure cannot, in our opinion, be regarded as in any way excessive in view of the great importance of the cotton crop both in India and the Empire as a whole. We would point out that, whilst the increased staff we have recommended is primarily for work on cotton, it will not, in the majority of cases, be employed exclusively on that crop. The additional Deputy Directors, for example, will be utilized in other directions. This will tend to the improvement of crops grown in rotation with cotton.

The figures we have given above suggest a further contrast. Great Britain spends on its Agricultural Departments £46 per 1,000 of the population, Queensland £92.5, Australia as a whole £86.5, the United States of America £36 and France £27. None of these countries can claim to be so predominantly agricultural as India and in comparison with them, the expenditure on agriculture in India can only be regarded as entirely disproportionate to its importance. We have every hope that when financial conditions improve, both the Government of India and Provincial Governments will be able and willing to make much larger assignments for agricultural development but if it is considered that the expenditure involved in our proposals is larger than Government would be justified in undertaking, we would mention that the evidence we received showed that no objection would be raised if a small cess of eight annas a bale were levied on all cotton consumed by the mills in India as well as on all cotton exported, provided the proceeds of such a cess were definitely earmarked for work on cotton in India. It would, in all probability, not be feasible to levy such a cess on cotton used outside the mills and therefore, if the conventional estimate of 450,000 bales for "extra mill" consumption be deducted, the proceeds of the cess would be in the neighbourhood of Rs. 20 lakhs. The cess we have recommended amounts to only one-fiftieth of a penny per pound and is, therefore, almost nominal. It could suitably be collected from the mills by the staff at present engaged in collecting the excise duty and on exports by the customs authority. We need hardly point out that, if Rs. 20 lakhs per annum could be made available for work on cotton, the programme we have recommended could be carried out on a larger scale and could be supplemented in various ways and that, consequently, more rapid progress would be possible. One advantage in the levy of a cess would be that it would be possible

to make grants to Native States, which might otherwise hesitate to accept our recommendations on the ground that to do so would involve an undue strain on their resources.

203. The greater part of the additional staff which we have proposed must be recruited at the outset either from the United Kingdom or the United States as Indian agriculturists with the requisite training and experience are not yet available in sufficient numbers. As we have already stated, time is of the utmost importance if India is to make any appreciable addition to the world's crop of cotton in the near future. It is therefore necessary that a thoroughly trained staff should be recruited as rapidly as possible from any available source. We realize, however, that the ultimate aim should be to recruit Indians for such post as those of Deputy Director or Economic Botanist and are of opinion that the activities of the Agricultural Colleges should be expanded so that trained Indian agriculturists may speedily be forthcoming. In order to give such men openings for appointment to the Indian Agricultural Service, as soon as they are available, we would suggest that candidates for some of the appointments, the creation of which we have recommended, might be recruited on short term agreements, i.e., for periods of five or ten years. In brief, we consider that the Agricultural Department must be very considerably expanded, that the ultimate aim should be a Deputy Director for each main agricultural tract, if not for each district, that the pay should be such as to attract the best men and that the best men should be recruited, at the outset, from any available source, the ultimate goal being the recruitment of the Indian Agricultural Service from Indians possessing the highest agricultural qualifications. Whilst the primary object with which we have recommended an increased staff is the improvement in the outturn and the quality of the cotton crop, such an improvement is bound to react on the general agriculture of the country.

There is every reason to anticipate that if the staff we have proposed is entertained as soon as possible, if adequate control of the distribution of seed of selected varieties is secured and if the improvements in agricultural practice we have recommended in preceding chapters are adopted, there will be an appreciable increase in the near future in the outturn of Indian cotton and a marked improvement in its quality.

204. Our recommendations and conclusions in this chapter may be *Summary.* summarized as follows :—

(1) Botanical surveys of the cotton growing tracts are of very great importance. Simultaneously with or subsequent to such surveys, the varieties found on a field scale should be tested on duplicate or triplicate plots in order that it may be ascertained whether any of the types is distinctly superior to the others.

(2) Selection work should be regarded as the first step in obtaining an improvement in cotton but should be followed by cross-

ing which should, however, only be entrusted to properly qualified officers who can devote personal attention and considerable time to it.

- (3) Tests of cotton on a field scale should be carried out in two series, the first series consisting of preliminary tests on small plots and the second series of tests on larger plots under conditions approximating as far as possible to those under which cotton is ordinarily grown.
- (4) As regards the question of obtaining an improvement in the outturn of cotton, one of the most important requirements is the introduction into the rotation of a heavy yielding leguminous fodder crop.
- (5) The selection and distribution of pure seed should be entirely controlled by the Agricultural Department. The desirability of taking immediate steps to select and acquire land for seed farms should be considered.
- (6) Demonstration should ordinarily be carried out on the lands of selected cultivators. Where the establishment of large demonstration farms is considered desirable, an accurate profit and loss account should be maintained.
- (7) No further work on tree cottons should be done by the Agricultural Department, except where it is desired to obtain crosses between such cottons and annual varieties.
- (8) An additional mycologist should be appointed to the Pusa staff whose principal duty should be the investigation of mycological problems connected with cotton.
- (9) The total cost of the proposals for the expansion of the Agricultural Department and for the Central Cotton Committee amounts roughly to Rs. 16 lakhs. If considered desirable funds might be provided by the imposition of a cess of eight annas a bale on all cotton used in the mills in India or exported.
- (10) The additional staff proposed should be recruited immediately from any available source. In some cases, candidates from the United Kingdom or the United States might be recruited on short term agreements, in order that their place may be taken by Indians possessing the requisite agricultural qualifications as soon as they become available.

PART II

to be used and their inspection, verification and correction and so on. Unauthorized markets and bazaars may be prohibited. Detailed rules under the Act in regard to the points mentioned above were promulgated in a Notification dated April 1st, 1898. The Act and the rules framed under it will be found in Appendix VI. There are at present 21 cotton markets in Berar. The system in force in the Central Provinces is somewhat different. Under Section 105 of the Central Provinces Municipal Act of 1903, Municipal Committees have power to frame by-laws, which are subject to confirmation by the Chief Commissioner, for the inspection and regulation of cotton markets and for the charge of fees for the use of buildings and places therein. Nine cotton markets have so far been established under these provisions, the most important of which is at Nagpur. The by-laws regulating these are less elaborate than those in force in Berar.

We consider that the rules under which cotton markets have been established and are regulated in Berar are excellent and we understand that they work well on the whole, the most serious weakness in the market administration being the unwillingness of the committees to take energetic action, owing to the fact that the majority of their members are *aratyas* (general commission agents) or large buyers, who do not wish to offend the class to which they belong or on which they are very closely dependent for a successful season's trade. This, however, is a defect which time will probably remedy as men of more independence of character become available with the spread of education. The advantages of the Berar system are that the cultivator is brought into direct contact with *bonâ fide* purchasers and is, therefore, in a position to sell his produce when and to whom he likes and that, as a result of the open competition in the market, he can secure the full competitive price for it. He is also paid for the full weight of his cotton, a matter in regard to which there is every reason to believe he is frequently cheated by the village *bantias* and the ginning factory owners. In an open market, the buyer actually sees the cotton he is buying and can fix the price he is willing to pay, according to its quality. The establishment of such markets should, therefore, have important effects in regard to the promotion of clean picking, and the prevention of damping, mixing and adulteration. We consider it most desirable that markets on the Berar system should be established in other provinces, and are of opinion that conditions throughout the cotton tracts of the Bombay Presidency (except Sind), the Madras Presidency (with the exception of the Coconada tract, as the area under this variety is not sufficiently concentrated) and the Punjab Canal Colonies are especially favourable to the establishment of such markets, owing to the fact that the proportion of cotton to other crops in those areas is high. We therefore recommend that steps in this direction should be taken without delay. The markets might either be established, as in the case of the Central Provinces, by the introduction of suitable provisions in the provincial Municipal Acts under which, at present, only markets for the sale of provisions are regulated, or if the local conditions are such that it is desirable that markets should be established in places which

have not been constituted municipalities, under a special Act for the purpose as in Berar. In the remainder of the Punjab and in the greater part of the United Provinces, the areas under cotton are probably too scattered at present to justify the establishment of cotton markets, but we consider that the question should be thoroughly investigated by the local authorities.

206. In connexion with the establishment of open markets, we have considered whether the publication in up-country markets of the prices prevailing in the Liverpool and Bombay markets would have any effect in enabling the cultivator to obtain a better price for his cotton. A system of publication is in force in the Punjab, where the price of Broach cotton at Bombay and of Punjab American and *deshi* cotton at Lyallpur are posted daily in the *mandis* (markets) together with a method of working out, from the Bombay price, the proper price of the *kapas* of the district in which the *mandi* is situated. The daily prices of certain grades of cotton prevailing in Bombay are also telegraphed daily to Beawar and Kekri, the principal cotton centres of Ajmer-Merwara. After consideration of the evidence placed before us in regard to the working of this system and the possibility of its extension, we are of opinion that the publication of Liverpool prices in up-country markets is unlikely to result in any advantage either to dealers or cultivators, as the great majority of them are quite unable to understand the significance of prices expressed in pence per pound, and the Liverpool price quoted is for "middling American," a variety in which their interest is too indirect to make the publication of its price of any real value to them. We do not, therefore, recommend the publication of Liverpool prices. We are somewhat doubtful about the advantages likely to be derived from the publication of Bombay prices but, on the whole, are inclined to think that it may result in benefit to the cultivators. We would, however, only recommend publication with certain limitations. In districts, which have properly regulated markets under the supervision of market committees, as in the Central Provinces and Berar, we are of opinion that the price quoted for the cotton of the district in Bombay should be given in rupees per *khandi* and that from it the corresponding price of *kapas* and lint which should prevail in the local market, after the necessary deductions have been made for freight and ginning, pressing and other charges, and due allowance has also been made for ginning percentage, should be worked out and posted. The cultivator will then be able to see for himself from a glance at the board the true price of his variety of cotton in the local market, and the price either for *kapas* or lint that he ought to obtain in that market. Our reason for confining this recommendation to properly constituted markets is that it is only in such cases that the somewhat complicated calculations necessary could be regularly and satisfactorily made. In tracts in which there are no market committees, but where the cotton grown is of varieties quoted in Bombay, we would only recommend the publication, in anything which approximates to a market such as the *mandis* in the Punjab, or in such other place as the Agricultural Department or the Municipal Committee

might consider suitable, of the Bombay price of the local varieties of cotton and the price of the *kapas* and lint of those varieties at the most important centre of the tract. Thus, at Montgomery and Gojra, the Bombay price of Punjab American would be posted in addition to the price of *kapas* and lint at Lyallpur. Where a variety is one for which there are no quotations in Bombay, it will be sufficient if the price of the latest transaction recorded in that variety in regard to which information is available is published. We do not consider it advisable that the price of Broach cotton in the Bombay markets should be published anywhere, except, of course, in the Broach tract itself, as this might promote a tendency to undesirable speculation. There is, however, we need hardly add, no objection whatever to the Agricultural Department obtaining full information in regard to both Liverpool and Broach prices and it would probably be advantageous for it to do so.

As to the cost of publication, where there are market committees, **Cost of publication.** we consider that it would be a legitimate charge on market funds. In other cases we are of opinion that it should be borne by the Agricultural Department, that is by Government, only at the outset. If the experiment proves successful, the cost might, in our opinion, suitably be met by the Municipal Committees or the District Board of the town or district in which the place where the prices are posted is situated. In this connexion, we would point out that the publication of prices is not in itself likely to put the cultivator in a position to hold up his cotton. This point will hardly be reached until his financial position is sounder than is usually the case at present. We look forward, ultimately, to the development of a system of Government warehouses as in America to which a cultivator or dealer may bring his cotton and obtain a receipt from the warehouse keeper, on which he can, if necessary, borrow money.

207. To place the cultivator in a better position to bring his cotton to an open market, it is necessary that he should be freed, as far as possible, from his indebtedness to the village *bania*. As a result of the very great increase in the price of cotton in recent years, the cultivator of cotton should now be in a stronger financial position than he has ever been. The rapid extension of the co-operative movement should also bring about a great improvement in this respect, especially where indebtedness has been incurred on account of advances for bullocks, seed or agricultural implements. It was represented to us that one reason for the indebtedness of the cultivator to the *bania* is that he has to pay his land revenue assessment before his crop of cotton is ready for marketing and has, therefore, to borrow in order to do so. We have carefully examined this point in regard to all provinces in which cotton is grown and consider that the dates on which the instalments of land revenue fall due are, in all cases, suitable except in the Bombay Presidency, exclusive of Sind, where in villages in which the principal crops are the cold weather (*rabi*) crops, the dates of the instalments have been fixed as the 5th February and 5th April. In

none of the cotton growing districts of Bombay, except Khandesh where cotton is a hot weather (*khari*) crop, is any cotton ready for marketing by the 5th February and we would therefore recommend that, in the cotton growing tracts of the Presidency proper with the exception of Khandesh, in regard to which we would propose no alteration, the dates of the instalments should be altered to the 5th April and 5th May.

208. Whilst we regard the establishment of open markets as much

Co-operative sale.

the most important step which can be taken to secure the cultivator an adequate price for his product, we would welcome a great extension of the activities of the Co-operative Department in this connexion. Partly, we believe, owing to the unwillingness of co-operative societies to handle agricultural produce and their preference for banking business pure and simple, the energies of the Co-operative Department in regard to cotton have been almost entirely confined to the formation of cotton seed societies and seed unions, the work of which has been dealt with in the provincial chapters. Owing to the superiority and purity of their produce, the members of such unions and societies are undoubtedly in a position to command a higher price for their cotton especially where, as in the Central Provinces and Berar, the cotton is ginned by a member of the seed union, but their effect on prices is much more indirect than that of a co-operative society formed specially for the sale of cotton. Of such societies there are at present very few in existence. In Bombay, four have been established in the East Khandesh District and four in the Dharwar District but these only commenced work very recently. In Madras, six regular seed unions were formed in 1916-17, the members of which undertake to gin and sell their lint jointly under the supervision of the Agricultural Department. These agencies have been working so short a time that it is impossible to offer any opinion as to the measure of success with which they have met, though we understand that higher prices were obtained for members of two of the societies in Dharwar at the auctions of Broach and Cambodia held by their societies than would have been the case if the cotton had been disposed of in the ordinary course through brokers (known as *dalals*). We should, perhaps, point out that the societies in Bombay are not truly co-operative in some respects, the management being largely in the hands of *dalals* and the societies, in order to increase their turnover, selling the cotton of non-members as well as of members. We should be glad to see these defects removed but we cordially approve the small beginning which has been made and trust that there will be a rapid expansion in the numbers and activities of these societies and unions. Their usefulness in eliminating the middleman and in educating the cultivator is a factor of the utmost importance. On the whole, we are of opinion that, in the preliminary stages, the Agricultural Department is the best agency for the initiation and supervision of societies and unions of this character.

209. We have described at length the system of auction sales adopted

Auction sales.

in the Punjab Canal Colonies and in parts of the Bombay Presidency in the chapters relating to those provinces. Where such sales have been undertaken, it

has been with the object of securing an adequate premium for a new variety grown under the supervision of the Agricultural Department whilst the quantity of the variety was small and the trade was without any organization to enable it to be taken up at its intrinsic value. It has been pointed out that the auction sales have not been altogether successful in securing the true premium for the cotton sold at them and there is no doubt that their sphere of usefulness is limited though, up to a point, they have proved of great value and were, in fact, the best agency available. The success achieved with Punjab 4 F cotton would certainly not have been so marked, if it had not been for their assistance. We regard them, however, as only a temporary step, if for no other reason than that the staff of the Agricultural Department is totally inadequate to handle very large quantities of cotton and that its energies can be more usefully employed in other directions. We consider, therefore, that they should only be continued until such time as they can be taken over by co-operative societies or by private agencies which are willing to co-operate with the Agricultural Department in any measures which it may consider necessary to secure the control of seed. As to the point at which auction sales should normally cease, we are of opinion that the Agricultural Department should not attempt to deal with more than 60,000 maunds of *kapas*, i.e., the equivalent of about 4,000 bales of lint. This would give it control over 40,000 maunds of seed which is sufficient for 400,000 acres. This stage should, if conditions prove reasonably favourable, be reached in five to ten years after a new variety is put out, though the length of time taken to attain it would, of course, vary according to the measure of success achieved by the variety. After it has been reached, the Agricultural Department should be able to make arrangements to secure the seed it requires from the agencies to which the sales are handed over. The auction sales which were organised last season by certain large landholders in the Punjab show that the work can be successfully carried out by private agency. There appears no reason why smaller landholders should not combine to hold their own auctions, the Agricultural Department, at the outset, giving advice and assistance, especially in regard to such matters as grading, classification and the settlement of disputes. We understand that, in some cases, small landholders were encouraged to avail themselves of the facilities offered by the private auction sales in the Punjab, an instance of public spirited action which is worthy of imitation.

210. We have considered the possibility of establishing buying

Buying agencies.

agencies, as a means, alternative or supplementary to that of auction sales, of securing to the cultivator an adequate premium for a new variety of cotton. By buying agencies, as the term has been understood in the past, has been meant a syndicate formed by the Bombay Millowners' Association or a similar body, which would make arrangements to buy cotton on the spot in consultation with the Agricultural Department and would get the cotton ginned, pressed, baled and placed on the market. Two such syndicates have been formed, on both occasions by the Bombay Millowners' Association, one of which commenced operations in Sind in

1912-13 and the other in Surat in the same year. Unfortunately, in neither case, were the operations successful. The failure in Sind appears to have been due to the too sanguine estimates which had been formed by the Bombay Agricultural Department of an immediate increase in the area under American cotton. In Upper Sind, where the syndicate established a ginning factory at Shikarpur, it had not been definitely established that American cotton could be grown in commercial quantities, whilst, in Lower Sind, sufficient allowance had not been made for the thoroughly unsatisfactory character of the irrigation from the Jamrao Canal. In the case of the Surat syndicate, the failure seems to us to have resulted from the fact that the cultivators were under no compulsion to dispose of their cotton to the syndicate, a cause which also contributed to the failure of the operations in Sind. This resulted in disputes between the syndicate and the cultivators in regard to the quality of the cotton and the price which should be paid for it, with consequent mutual dissatisfaction. We find it difficult to see how any agency of this character can work satisfactorily unless the cultivator is compelled to dispose of his cotton to it, a step which we are quite unable to recommend as we do not think it desirable that any agency should be given a monopoly. The establishment by a combination of firms, either in the cotton trade in India or elsewhere in the Empire, of agencies of their own up-country in India, would doubtless have an excellent effect in bringing the ultimate consumers in more direct touch with the first sellers of cotton and would, by so doing, enable proper prices to be obtained for small quantities of new varieties. But this is, in our opinion, a matter for the trade itself and appears to us to be somewhat beyond the functions of Government.

211. In connexion with the question of marketing, our attention has

Forward sales.

been drawn to the forward sales which are made by cultivators and middlemen especially in seasons of high prices such as are at present prevailing. It has been represented to us that such sales are objectionable as, even if prices do not rise between the time at which the contract is made and that at which the cotton is delivered, the tendency of the middleman and, to a less extent, of the cultivator is to tender as low a quality of cotton as he thinks is likely to be accepted against his contract. The tendency naturally becomes much more marked in a year in which prices have risen rapidly. Whilst there appear to us to be substantial grounds for the complaints of deterioration resulting from this practice, we do not see how any steps can be taken to prevent it or that there would be any justification for interference with the cultivator in his attempt to make certain of a profit on the whole or a portion of his crop by selling it forward. We are, however, of opinion, that the establishment of markets on the Berar system should do much to reduce the practice of forward selling as it would make the cultivator much more certain of securing the intrinsic value of his cotton. It follows, from what we have said, that we do not desire any steps to be taken in regard to the purchase of cotton "forward" by mills or exporters in the ordinary course of trade. In short, we do not wish to see the liberty of the cultivator to sell his cotton, when, where, and to whom he likes, fettered in any way.

212. Before leaving the general question of marketing, we would mention that, during the course of our tour, our attention was frequently called to the hampering effect on the cotton trade which results from the great variety in the weights used for transactions in cotton not only in different provinces but also in different districts and parts of districts in the same province. Over the greater part of the Bombay Presidency, cotton is bought and sold on the basis of a *khandi* of 784 pounds of lint, which is, in consequence, known as the Bombay *khandi*. In the south of the Presidency, the unit is the *nag* of 336 pounds. In Khandesh, the *khandi* varies from 160 to 250 pounds and the weight of the *maund* varies from 42 pounds at Bodwad to 144 pounds at Dhulia and Amalner. The Madras *khandi* is only 500 pounds of lint, but in the "Westerns" tract, cotton is sold by the *nag* of 312 pounds. At Cawnpore, there is a special cotton *maund* of 100 pounds for both lint and *kapas*. In other parts of the United Provinces, the standard *maund* of 82½ pounds is generally used for *kapas*, lint being sold in bales of 400 pounds. In the Punjab and Sind, both *kapas* and lint are sold on the standard *maund* of 82½ pounds. It is only in the Central Provinces and Berar that the weights used in the cotton markets have been prescribed or are regulated by Government. In both cases, the *maund* used is one of 28 pounds. Under the by-laws of the Nagpur market, the *khandi* is one of 784 pounds of *kapas* and a *bhoja* means 392 pounds of lint. The *khandi* and the *bhoja* are not defined in the rules of the Berar markets but are, in practice, the same as those in use at Nagpur.

The advantages to the trade which would result if some uniform system of weights could be adopted for all transactions in cotton are so obvious that they need not be enlarged upon. At the same time, a fruitful source of loss to the cultivator would be removed. There is no doubt that the present lack of system offers great opportunities for cheating him, of which many dealers and others are not slow to avail themselves and they are assisted in doing so by the fact that, even where the *maund* is in use, many of the weigh-bridges in ginneries are marked in hundred-weights, quarters and pounds instead of in *maunds*. We are, therefore, strongly of opinion that in the interests both of the trade and of the cultivator, the weights used in cotton transactions throughout India should be standardized. The Bombay *khandi* is such a well-known weight and is already in use in so many of the principal cotton tracts in India that we consider it desirable that the standard weights should be sub-multiples of that. We do not, therefore, support the recommendation of the Weights and Measures Committee of 1913-14, that the standard *maund* of forty *seers* or 82½ pounds should be adopted as this is only used, at present, for cotton transactions in the Punjab, Sind, and parts of the United Provinces, does not correspond to the avoirdupois scale and bears no relation to any of the *khandis* in use in cotton growing tracts. The *maund* we would recommend is one of 28 pounds. Fourteen *maunds* would then be equal to one *bhar*, *naga*, or *bhoja* of 392 pounds and two *bhars*, *nagas* or *bhojas* would be equal to one *khandi* of 784 pounds. The advantage of this scale is that it fits in with the scale which, as we

have pointed out, is in use in the Bombay markets as well as in the principal cotton growing tracts. It also fits in with the weight of the ordinary bale which, everywhere in India, except in the south of Madras where it is 500 pounds, is 400 pounds gross. The allowance for tare is eight pounds which reduces the net weight of the bale to 392 pounds or exactly half a *khandi*. Its adoption would therefore cause the least dislocation and inconvenience to the trade. To avoid confusion, we would recommend that the *maund* we have suggested should be known as the "cotton *maund*." We consider it desirable that all the weights used in cotton transactions should be in pounds avoirdupois and, in our opinion, the introduction of the *seer* into the scale would only cause unnecessary complications.

213. As regards the measures which should be taken to bring about a universal adoption of the scale suggested above, we have included in the scheme for the licensing of ginneries and presses put forward in paragraphs 223 *et seq* below, a recommendation

Measures necessary to bring about standardization of weights.

that one of the conditions on which licenses should be granted to ginneries and presses should be that only the certified standard weights prescribed for the tract should be used. We would further recommend that, in the legislation we have proposed in regard to the establishment of cotton markets in provinces other than the Central Provinces and Berar, power should be taken to prescribe standard weights to be used in such markets and that, in any rules framed under such legislation, a rule should be inserted similar to that already in force in Berar, under which the Chairman of the Market Committee, every member of the Committee and every employee of the Committee duly authorized to do so, are entitled, at any time and without notice, to inspect, examine and test any scale or weights used, kept, or possessed in any open place within the limits of a market. If standard weights are prescribed for markets, ginneries and presses, there can be no question but that their adoption for all transactions in cotton will follow in a very short time. The weights, which we recommend should be kept in all markets, ginneries, and presses, are the following:—1, 2, 4, 7, 14, 28, 56 and 112 pounds. These weights would be duly tested and stamped before issue and arrangements should be made to retest and restamp them every year, as well as to test all scales in use, in order to prevent the possibility of their being tampered with, as is not infrequently the case with the weights and scales used at present. We would further recommend that all weigh-bridges and platform-bridges in use in markets, ginneries or presses, should be marked with the above scale. We are so impressed with the disadvantages of the present system, both to the trade and the cultivator, that we consider that, if there are difficulties in prescribing uniform standard weights for the whole of India, an attempt should, at any rate, be made to secure uniformity within each province.

214. The condition in which Indian cotton is placed on the market as the result of the practices of adulteration, mixing and damping has made it a by-word in certain markets almost throughout the history

Adulteration, mixing and damping of cotton.

of the British connexion with India. The question of restoring its reputation by the prevention of these malpractices is one to which we have given the most serious consideration. The evidence which has been submitted to us shows, in our opinion, that the cultivator is only to a small extent responsible and that the bulk of the adulteration, mixing and damping which is practised is carried on in the ginneries and presses. A certain amount of admixture is undoubtedly due to the fact that the cultivator often grows, and consequently sells, a mixture of different varieties of cotton, in some cases because he can obtain nothing but mixed seed from the ginneries and, in others, because the cotton of the tract is a natural mixture. The measures we have suggested in the provincial chapters, especially in regard to the distribution of good seed of pure varieties, should have a considerable effect in reducing the mixture of cotton arising from this cause. It may also happen that the cultivator deliberately grows cotton of an inferior variety for the purpose of mixing it with a superior variety growing in the same tract. The only instance of this kind which came under our notice was that of *pulichai* in the Tinnevely district of Madras, and merits a brief description. *Pulichai*, a variety of *neglectum* cotton, probably *roseum*, appears to have been introduced into the Tinnevely tract from the Central Provinces about 1909. Its yield per acre was about the same as that of Tinnevely cotton, but its ginning percentage was at least five per cent. higher. In these circumstances and as the price of Tinnevely cotton could be obtained for it by mixing the two varieties, its cultivation made rapid progress and by 1915, its presence in the Tinnevely crop constituted a serious danger to the reputation of the latter. It was felt that if this was to be preserved, combined action on the part of the Agricultural Department and the trade was imperative. After some negotiation between the two, all the buying firms interested in Tinnevely cotton agreed not to purchase any *pulichai* cotton pure or mixed in the season of 1917. Leaflets announcing the fact were printed in the vernacular and distributed widely before the sowing season commenced in 1916. The Agricultural and Revenue authorities co-operated in dissuading the cultivators from sowing *pulichai*. In consequence, the area under it fell to one-third that of previous years. It was not, however, eradicated, and although the firms agreed to take cotton on the understanding that the *pulichai* mixed in it should not be paid for, more stringent measures were considered necessary. Finally, all the firms concerned entered into a formal legal agreement permitting inspection of their yards and books by a selected officer of the Agricultural Department and the imposition of penalties if it was found that any *pulichai* had been paid for. In consequence of their action and of the distribution of the variety of *karunganni* cotton known as Company No. 3, which yields the cultivator a better return per acre than *pulichai*, the latter has been almost completely stamped out though it still exists as an impurity in the crop over a wide area. The successful campaign against it shews that, in certain circumstances, the combined action of the trade and the Agricultural Department can be extremely effective in preventing a mixed crop being grown. We would, however, point out that conditions in Madras are

of a somewhat special character, as the trade is in the hands of a few large firms and thus combination and co-operation with the Agricultural Department are rendered very much easier than would be the case elsewhere. It is, of course, impossible to prevent the cultivator growing any crop he likes but we consider that the general effect of the proposals we have made in the provincial chapters and in this chapter should be greatly to reduce, if not entirely to obviate, the likelihood of his growing different varieties for the purpose of mixing. As regards the admixture for which the village *bania* is responsible, we have suggested certain remedies above, the most important of which is the establishment of open markets.

215. One factor which contributes largely to the unsatisfactory state in which Indian cotton is marketed is the **Unsatisfactory methods of picking.** methods which are employed in picking it and for these the cultivator must be held almost entirely responsible, though it must be pointed out that, owing to the dryness of the Indian climate, it is impossible, except perhaps in the coast tracts, to pick cotton as clean in India as in America. Under present conditions, ripe and unripe bolls are picked indiscriminately owing to the cultivator's desire to get the whole of his crop picked with the labour he has already secured. If cotton is picked early in the morning, when the ground is wet with dew, no trouble is taken to dry it, and the *kapas* is marketed in the damp condition in which it has been picked. If it is picked later in the day, the leaves of the plant and the valves of the bolls are brittle and come away and are mixed with the *kapas*. The *kapas* is frequently heaped on the bare ground and consequently becomes mixed with dirt, sand and small stones. The methods of picking are especially unsatisfactory in the Kumpta-Dharwar tract in Bombay and in the "Northerns" and "Westerns" tracts of Madras. The loss resulting from bad methods of picking must, in the aggregate, be considerable. In the first place, railway freight is incurred unnecessarily on the foreign substances contained in the cotton. In the second, the blowroom loss on cotton badly picked is very heavy and the additional processes through which it has to pass in order to get it into a condition in which it can be used weaken the staple. Finally, it is impossible entirely to extract all the leaf and the cloth ultimately produced from badly picked cotton is, to some extent, inferior in quality. This is bound to react on the price the cultivator obtains for his produce.

216. The only way in which cleaner picking of cotton can be secured is by convincing the cultivator that it pays him better than his present haphazard methods. **Remedies.** Very little has so far been done in this direction. Cotton systematically picked by a large landholder in the *kumpta* tract and sent to a local mill lost only five per cent. in the blowroom against twelve to fourteen per cent. from cotton picked in the usual way but was valued by the mill only at about seven to nine per cent. more than the cotton ordinarily bought from respectable merchants. Experiments carried out by the Madras Agricultural Department also show that, in present condition a premium cannot be obtained for clean cotton sufficiently high to make

it worth the cultivator's while to produce it. In the Madras experiments, the stained and damaged *kapas* was picked out and marketed separately, but the buyer merely paid very little more than the market rate for ordinary *kapas* for the better quality and considerably less for the remainder so that, for the whole lot, the cultivator obtained less, or at least no more, than he would have done if it had all been of one quality, in spite of the fact that he had incurred an expenditure estimated at Rs. 3 per acre on careful picking. We do not, however, consider that these experiments were carried out on a sufficiently large scale to make their results conclusive and think that the difficulty in obtaining a suitable price for the clean cotton was due to the smallness of the quantities offered and the consequent difficulty on the part of the buyer in marketing it separately. We would, therefore, recommend that, in tracts in which the methods of picking are not satisfactory, the Agricultural Department should select a village or group of villages capable of producing not less than 100 bales of cotton, get the cotton in it picked properly and make arrangements to market it separately, in order to enable a definite conclusion in regard to the value of the cotton so picked to be arrived at. We have little doubt that if this procedure were adopted, the advantages of clean picking would be established. The provision of open markets in which the buyer can see the *kapas* he is purchasing and pay a suitable premium for cotton picked clean should also tend to improve matters.

217. As to the time of picking, it is undoubtedly the case that the chances of mixture with foreign substances are lessened if cotton is picked early in the morning before the leaf becomes brittle. The objection to early picking is that the cotton is often marketed with the dew still on it. As an extreme case of this, we may mention the experience of one firm in the Moradabad and Etawah districts of the United Provinces which was that, out of one maund of forty seers of *kapas* paid for, the actual quantity available within a few hours of drying the *kapas* in the sun was only thirty seers. We regard early picking, however, as the lesser evil especially as it is only in the North of India that heavy dew persists late in the day during the cotton picking season and also as it is easier for the buyer to refuse damp *kapas* or to make a suitable allowance for the amount of dampness in it than to allow for impurities such as bits of leaf, valves of the boll, etc. We recognize that picking early in the morning would mean, in some cases, a change in rural economics, the reason for picking late in the day being that the women prefer to do their household work before going to the fields.

218. A point which arises, in this connexion, is in regard to the system of payment for picking which is usually adopted and which consists in paying the pickers a proportion of the day's pickings which varies throughout the picking season according to the state of the crop. This system tends to make the pickers careless, as their sole object is to secure as heavy a weight of *kapas* as possible. The small lots of cotton obtained as the day's wages are usually disposed of to the village *bania* and are lumped together by him, forming a fruitful source of mixture of seed.

In these circumstances, payment in money or in grain should bring about an improvement in the quality of the cotton picked, especially if the pickers were provided with bags and were not allowed to heap the cotton on the bare ground. Here again, we recognize that the present method has the advantage, from the cultivator's point of view, that it relieves him of the necessity of keeping his labourers up to the mark and enables him to get his crop harvested more quickly. Any alteration in the time of picking and in this system of picking can only come about gradually as the advantages of clean picking are brought home to the cultivator and we do not therefore consider it necessary to make any specific recommendations under these heads.

219. We would again reiterate our conviction that the malpractices for which the cultivator and the village *bania* are responsible are of minor importance compared with those which are carried on in ginning and pressing factories. The evidence in regard to these we received was overwhelming and the numerous inspections of ginneries and presses which we made showed us that the complaints were entirely justified. We would make a differentiation between deliberate malpractices and abuses which merely arise from faulty conditions. As to the former, it has, we regret to say, been definitely established that, in a large number of ginneries and pressing factories, watering of cotton takes place, though there has been a considerable improvement in this respect in recent years. Cotton is mixed with waste imported from mills specifically for the purpose. Cotton damaged by rain is mixed with good cotton. Cotton of different varieties is mixed, short staple or inferior cotton being often imported from places hundreds of miles away to be mixed with cotton which has a better reputation and commands a higher price. Ginning machinery is adjusted in such a way that cut or crushed seed is allowed to pass into the ginned cotton and seed or unginned cotton is placed in the middle of ginned cotton. As regards abuses which arise out of faulty conditions, most of the ginneries we inspected have no separate entrances and exits for *kapas*. Coolies bringing in *kapas* cross others carrying out lint, and the *kapas* and lint, which fall from the heaped up bundles, are mixed together and usually form part of the next bundle of lint that is taken out. The platforms behind the gins on which the *kapas* is stored are usually very narrow. Too large a quantity of *kapas* is stored on them with the result that some of it falls over the gin into the ginned cotton, into which, also, seeds and dirt fall from the gin owing to insufficient attention being paid to keeping it in proper order. It is generally the case that no part of the compound of ginning and pressing factories is paved and that the godown accommodation provided is quite insufficient. Cotton both before and after ginning and pressing is heaped or rolled on the ground and left without any covering with the result that it picks up large quantities of dust and becomes damp from dew. In many ginneries, the *kapas* is not passed through an opener before being ginned and even where it is, fans are often stopped purposely in order to allow the dust beaten out to fly back into the cotton. We are much impressed by the magnitude of these evils and the necessity

of providing some remedy for them. We are unable to concur in the view that it should be left to the trade to deal with them. The extent to which they have grown shows that the trade has been powerless to deal with them in the past and we see little reason to believe that it will be in a better position to do so in the future. If it were only the trade that was affected by them, the argument for the continuance of a policy of *laissez faire* on the part of Government would be much stronger than it is. But, in our opinion, Government, the trade and the cultivator are equally concerned in securing an improvement in the state of affairs we have described. As we have already pointed out in Chapter I, there is a consensus of opinion that it is in the interests both of India and of the Empire as a whole that larger supplies of better cotton should be produced in this country. It is, however, self-evident that the efforts of the Agricultural Department to promote the extension of the cultivation of improved varieties of cotton must, to a large extent, be frustrated and that the expenditure of public money on them cannot, to that extent, be justified, if the cotton when produced fails to obtain its intrinsic value, owing to the condition in which it is marketed. The loss to the trade as the result of the practices of adulteration, mixing, and damping need not be dilated on. The protection of the interests of the third party, the cultivator, must always be a paramount consideration with Government in the case of a country which is so predominantly agricultural as India. That the existence of the malpractices in ginneries and presses, for which he is not at all or only to a very small extent responsible, must have a very serious effect on the price he obtains for his produce is a point which need not be laboured. If, as there is every reason to believe, the war will be followed by a period of keen competition among industrial nations, including India herself, for the raw cotton of India, that effect will be accentuated by the fact that the majority of the mills in England and the Continent, which are accustomed to use clean cotton, have not the blowroom machinery suitable for dealing with cotton in the condition in which it is exported from India and will therefore naturally turn first to other countries for their supplies. In these circumstances, we are emphatically of opinion that the time has come for somewhat drastic action on the part of Government. The steps which we consider should be taken are discussed in detail below.

220. As an instance of the prevalence of the reprehensible practice of mixing cotton waste and cotton fly with good cotton, we may mention that, in the railway station yard at Hubli, we found waggons containing nothing but cotton waste imported from Bombay, and that, in a ginning factory there, we saw such waste being mixed with *kapas* in the proportion of two maunds of waste to six of *kapas*. It is a matter for regret that railway waggons should be available for traffic of this character at a time like the present when there is such an urgent demand for them for genuine trade purposes. Cotton waste and fly can only be utilized legitimately by cotton and woollen mills in certain lines of manufacture or for the manufacture of munitions. The only satisfactory method by which the illegitimate use of it can be stopped is by the total prohibition

of the transport of such waste by rail, whether in the form of loose *boras* or full pressed bales, except from one spinning or weaving mill to another or from a mill to a port of shipment such as Bombay and we strongly recommend this course. We would enforce the same restriction in the case of transport by sea between Indian ports except from one Indian mill to another. In regard to the export of waste from Native States, our enquiries left us no reason to doubt that the Darbars would be willing to co-operate in any measures of this character that were decided on by the Government of India. If an agreement on the point failed to be reached, import of waste from a Native State into British territory could be totally prohibited.

221. A more difficult problem is presented by the mixing of different varieties of cotton, a practice to which, owing to the mixture of the seed that results from it, the complaints we received of the deterioration of many of the superior varieties of Indian cotton must be largely attributed. It is hardly an exaggeration to say that, with few exceptions, long staple cotton very seldom finds its way to the chief markets, especially to Bombay, in an unmixed state. Many districts which were formerly celebrated for their cotton have, in consequence, acquired a bad name both with Indian consumers and with exporters and, as it is impossible to detect that cotton contains a small mixture of an inferior variety before it passes through the spinning machinery, even pure cotton from such districts is approached by buyers with distrust and the price offered for it is reduced accordingly. The evidence submitted to us showed that the import of short stapled cotton into tracts which grow long stapled cotton for the purposes of being mixed with the latter and passed off as the produce of the long staple tract is extensively carried on. A special enquiry on the point made in the Bombay Presidency in 1909 showed that, during three months of that year, the imports of short stapled cotton into the Broach tract amounted to five per cent. of the whole crop. The Broach tract is one in which the practice is especially common and there is no doubt that the deterioration in the reputation of Broach cotton in recent years is, to some extent, due to this cause. The cotton so imported comes mainly from Khandesh. Cotton from this tract is also largely imported into Berar for mixing purposes and some of it finds its way to the Kumpta-Dharwar tract to be mixed with *kumptas*. We had ocular evidence of this fact in the Hubli railway station yard where we found several waggons containing Khandesh cotton which our enquiries showed had been imported for mixing as it was not consigned to the local mill. That the cotton should have been brought so far is evidence of the extent to which the practice pays. In this case also, we are of opinion that the only remedy lies in the total prohibition of the transport by rail of cotton, whether in the shape of loose *kapas* or lint in *docras** or in that of half pressed or full pressed bales, except to *bonâ fide* consumers, i.e., to spinning and weaving

Mixing of different varieties of cotton.

Prohibition of transport by rail.

* Bags of unpressed cotton.

mills or to ports for disposal there or shipment outside India. We recognize that certain exceptions will be necessary. The first case which has to be provided for is that of the removal of cotton from areas which have taken so lately to growing it that they have as yet no ginneries or pressing factories. In this case, until sufficient gins and presses spring up to meet the needs of the tract, we would permit transport by rail under license to ginneries or presses in adjoining districts. The second case is that in which a firm or individual buyer wishes to bring in cotton to be ginned or pressed at a central station in a district from outlying stations in the same district. We recognize that it might be a hardship to compel such a firm or buyer to erect a ginney or press at or near the place where the cotton was bought when there were factories within easy distance by rail. It might be impossible also for the firm or individual to get the cotton ginned or pressed locally owing to the owners of the local factories combining and refusing facilities. Instances of this kind have come under our notice. In this case also, we would only allow transport under license in order to ensure the legitimate use of the cotton so transported. In both cases, licenses should be issued only to a specified firm or individual for transport between the stations specified in it. They should be in force for one season only, but should be renewable on application. At the end of each season, a return of the total quantity transported under a license should be submitted to the licensing authority. Any breach of the terms of the license should be followed by its cancellation. The procedure in regard to the issue and withdrawal of licenses would be similar to that which has been suggested below in regard to licenses for ginning and pressing factories. In this case, as in that of the prohibition of the transport of cotton waste, legislation would be necessary. The insertion of suitable provisions in the Railway Act would meet the case but it would perhaps be preferable to have a separate Act covering our recommendations under these heads as well as the scheme for licensing ginning and pressing factories we have put forward below.

222. It will be observed that we have made no provision for the case

Transport by road.

of transport by road. Cotton is undoubtedly taken long distances by road for the purposes of mixing but there are obvious limits to the practicability of doing so which do not exist in the case of the transport by rail. Prohibition of transport by road would be extremely difficult to enforce and the cost would probably not be commensurate with the advantages gained. We feel that we are striking at the root of the evil in recommending the prohibition of transport by rail. If this measure does not prove as efficacious as we trust it will, it might be possible to test the effect of prohibition of transport by road within a particular limited area. We have no doubt of the cordial co-operation of the Governments of Native States in this matter as well as in regard to the transport of cotton waste, especially as they have already in some cases, notably that of Hyderabad and Gwalior, taken steps to safeguard the purity of the cotton grown in their territories. We would mention the strong support which the recommendations we are making under this head have received on all sides. We

would, also, point out that, if adopted, they will have the effect of putting a stop to the practice, which is at present very common, of railing cotton in full pressed bales from one station to another, the cotton normally exported from which has a better reputation and commands a higher price. The cotton is then rebooked from the latter station to its ultimate destination. The object of this device is to lead the buyer to believe, from the evidence of the railway station mark on the bales and of the railway receipt, that the intermediate station was actually the station of origin and to pay for the cotton accordingly.

Whilst the prohibition of transport of cotton by rail and sea except under the restrictions suggested above will stop the import of cotton for mixing purposes, it will not stop the mixing of different varieties which grow side by side in the same tract, such as Punjab *deshi* and Punjab American, Bengals and Khamgaon Akolas and ordinary Tinnevelles and *karunganni*. We are referring here to the case of deliberate mixture in the ginneries and presses. With the mixture for which the cultivator and the village *bania* are responsible we have already dealt. Cases were brought to our notice in which the owners of ginneries and presses in the Punjab deliberately mixed Punjab *deshi* cotton with Punjab American to the extent of twenty per cent. as they found that they could get a better price proportionately for the mixture than if the cotton were sold pure. In order to stop practices of this kind, we think that the only course is for the trade to penalize the mixed cotton. This will be easier in the future than it has been in the past if our proposals in regard to the marking of bales are accepted, as it will then be easy to trace the persons responsible for the mixture. We are unable to suggest any other remedy in cases of this kind owing to the impossibility of detecting a small mixture of inferior cotton before the cotton of which it forms part has passed through the spinning machinery. Much the more important part of the mixing which goes on will be prevented if our recommendation in regard to the prohibition of transport by rail and sea is accepted and such of it as results from the growing of different varieties side by side in the same area should diminish as each cotton growing tract becomes more and more the home of one variety only, as is contemplated in our recommendations in the provincial chapters.

223. Whilst we feel that the recommendations we have made in the preceding chapters will do much, if adopted, to enhance the reputation of Indian cotton, we are of opinion that they are not, in themselves, sufficient to stop the malpractices we have described and that this result can only be secured by a system of licensing ginning and pressing factories. In making proposals to this effect, we have given full consideration to the history of the Bombay Cotton Frauds Act. We shall revert to this point later and hope to show that the scheme we put forward is not open to the objections which were urged against that Act and which finally led to its repeal in 1881. We realize the importance of ginneries and presses as a necessary link in the cotton trade between buyers and

consumers and wish to emphasize that nothing we propose will, in the least, interfere with legitimate ginning and pressing. Control of ginning and pressing factories, however, appears to us to be the only way in which the reforms we consider essential can be brought about, more especially as the conditions under which cotton is ginned are rapidly becoming worse in large areas, such as the Cambodia tract in Madras, owing to the erection of a large number of small factories containing sometimes as few as three or four gins.

We recommend, therefore, that all ginning and pressing factories should be required to take out licenses, the authority which would issue and withdraw such licenses being the Local Government acting in consultation with the Central Cotton Committee and the Provincial Committees in accordance with the scheme which we have proposed in Chapter XIX. For this purpose, it would be necessary to have an Act of the Governor General in Council in the framing of which the Central Cotton Committee would be consulted. It would also be consulted in regard to any rules framed under the Act by Local Governments.

224. The first object of a system of official licenses would be to enable cotton in regard to which any complaints were made to be traced back to the original pressing or ginning factory from which it issued in order that suitable action might be taken in regard to it. For this purpose, the licensing authority should assign to each ginning and pressing factory a serial number which, in the case of a ginning factory, it should be required to stamp on every package or *bora* of loose cotton. In the case of a pressing factory, the serial number of the ginney from which the cotton came as well as the serial number of the press should be stamped on the flat side of every bale which left the premises. In both cases, the name of the station at which the cotton was ginned or pressed should also be stamped on every *bora* or bale of cotton issuing from the factory. Thus, to take the case of a ginning factory at Multan, the mark "Multan G.51" on a *bora* of loose cotton would show that the cotton had been ginned in a certain factory at Multan whilst "Multan G.51 P. 81" would show also the factory at which it had been pressed. We understand that, in most pressing factories, every bale is given a serial number which is stamped upon it. The practice is, however, not universal and we consider that it should be invariably followed. Objection may be taken to the system of double marking proposed in the case of bales on the ground that the owner of a pressing factory may press cotton for a client who has had it ginned at more than one factory and that it may be difficult to keep cotton ginned at different factories but belonging to the same owner separate. To meet such cases, the name of the owner of the cotton might be stamped on the bale instead of the number of the ginning factory, the owner of the press, however, keeping a record of the ginning factories from which the cotton came. This would give all the information necessary to enable the cotton to be traced back to the ginning factories.

225. Licenses should, in our opinion, be granted to pressing and
Conditions on which licenses ginning factories on the conditions specified
should be granted. below.

- (a) All ginning factories hereafter to be erected should conform to the standard plan attached to this report, suitably modified, if necessary, to suit the conditions of the various provinces. The plans have been kindly drawn up for us by Messrs. Marshall, Sons and Company of Bombay, who have special experience of this class of work. They appear to us to be in every way suitable and we consider that they represent the minimum standard which should be required in the case of new factories.
- (b) All existing ginning factories should be provided with sufficiently wide platforms for *kapas* and lint. These should, in no case, be less than five feet wide for each set of gins, exclusive of the width of the gin. In the case of factories with two sets of gins, which are more than 24 feet but less than 27 feet wide and of which there are a large number, the necessary width of platform can, in most cases, be secured by replacing the *kapas* platforms along the sides of the factory by a joint platform in the middle which would serve both sets of gins, and no structural alterations should, therefore, be required. It is only in the case of factories less than 24 feet wide that such alterations would be called for. If a central *kapas* platform is provided, it should be at least seven feet wide. All factories should be provided with separate entrances for *kapas* and exits for lint so as to remove all possibility of lint and *kapas* becoming mixed when the coolies carrying them cross each other. We would allow twelve months after the necessary legislation has been passed in which to carry out the alterations required, the licenses to be cancelled if they are not completed within this period.
- (c) All ginning factories should be provided with paved platforms for *kapas* in the compound and also with sufficient godown accommodation. We consider the size of the platforms and godowns a matter which may be left to the discretion of the licensing authority but would suggest that the minimum should not be less than would hold sufficient *kapas* to keep the factory working for four days.
- (d) All press houses should be paved.
- (e) All ginning factory-owners should undertake to keep their gins in good working order, to keep the knives properly set and the rollers so adjusted as not to permit cut or crushed seed to pass into the lint.
- (f) The owners both of ginning and pressing factories should undertake to submit regularly and punctually such returns as may be prescribed by Government from time to time and to certify the correctness of the returns so submitted.

- (g) The provisions of the Factory Act in regard to such matters as working hours, the employment of women and children, the fencing of machinery, etc., should be strictly observed.
- (h) Only the certified standard weights prescribed for the tract should be used and also correct scales so as to ensure that both cultivators and dealers are given correct weight.
- (i) The owner of a ginning factory should undertake to keep a complete daily record of all the cotton ginned in his factory, showing in details the name of the merchant from whom it was bought or for whom it was ginned, the variety of cotton ginned, the weight of each *bora* and the number of *boras* ginned daily. In the case of a pressing factory, the daily record would show the name of the ginning factory from which the cotton came, the name of the person for whom it was pressed, the weight of each bale and the number of bales pressed daily. In both cases, the owner of the factory should also undertake to mark *boras* or bales with the number assigned to the factory under the system proposed above.

It may be thought that the daily record here suggested is of too elaborate a character and that its prescription may entail hardship on factory-owners. We understand, however, that complete records of this character are maintained by all reputable ginning and pressing factories.

- (j) Access to ginning and pressing factories must at all times be given to any members of the Central Cotton Committee or of the Provincial or local Committees, to the Collector or Deputy Commissioner of the District, to gazetted officers of the Agricultural Department and to officers of the Factory Department for all purposes including the verification of records and returns.
- (k) Owners of ginning factories should undertake to carry out all regulations for the disposal of seed which may be made by Government from time to time.

We have inserted this condition to meet such a case as that of the United Provinces, where large quantities of seed infested with bollworm and therefore useless for sowing purposes, is sold by ginning factories. This evil may become so serious as to necessitate the issue of regulations in regard to the disposal of such seed. The condition would also be applicable to cases in which it was considered necessary to keep and store seed from different varieties of *kapas* separately.

- (l) Where any ginning or pressing factory works at night, such factory should be adequately lighted to the satisfaction of the Factory Inspector or the local Committee.

This recommendation is made as the evidence submitted to us showed that night working facilitates every kind of abuse. We think, however, that it is a matter which might be more

suitably dealt with by a provision in the Factory Act and that night working with inadequate light might be made an offence under that Act.

- (m) Owners of ginning and pressing factories should undertake to work for at least eight weeks in the year, unless prevented by causes beyond their control, such as a short crop, cases of this kind to be dealt with on their merits by the Central Committee.

This condition is inserted with a view to stopping, as far as possible, the erection of ginning and pressing factories which are not intended to work but are merely put up with a view to sharing in the profits of pools. We have dealt with the question of pools in paragraph 231 below.

The above conditions, with the exception of conditions (a), (b) and (e), should, in our opinion, apply to all factories whether the gins in them are saw gins or roller gins. We have not considered it necessary to have a standard plan prepared for new factories with saw gins as few factories of this character are likely to be erected in India in the near future. Even in the case of such factories, however, we hold the view that no license should be granted unless the licensing authority is satisfied that the accommodation provided is sufficient to enable cotton to be handled in such a way that the accidental mixing of *kapas* and lint is impossible. In view of the very small number of saw ginning factories already in existence in this country, a point to which further reference will be found in paragraph 232 below, we would not, in their case, insist on any structural alterations as in condition (b) but we consider that condition (e) above should apply *mutatis mutandis* and that the owners of the factories should undertake to keep their gins in proper working order. The conditions we have laid down would, of course, require suitable modification to meet the case of factories which have both saw gins and roller gins.

226. As regards the procedure which should be followed in respect of the issue of licenses, it is, we think, for the Factory Department to certify that a new ginnery conforms to the standard plan and that existing ginneries and presses have been brought up to the standard laid down in conditions (a) to (d) in the preceding paragraph. Licenses would then be issued by the licensing authority in the case of new ginneries and presses. We consider that licenses should be issued to all ginning and pressing factories already in existence at the time of the passing of the Act which apply for them but should be withdrawn on a report by the Factory Department that the specified changes have not been carried out within the period of one year after the passing of the Act which we have suggested above.

227. In this connexion, we would mention that the Factory Act does not at present apply to ginning and pressing factories which employ less than fifty persons. As we have already stated, a large number of small ginning factories, containing as few as

Application of the Factory Act to factories employing less than fifty persons.

three or four gins, have been erected in recent years, especially in the Madras Presidency. As these are subject to no control or inspection, the abuses prevalent in the bigger factories are reproduced in them on a larger scale. The fact that no restrictions are placed upon them in such matters as the employment of women and children, the hours for which they can be employed and the fencing of machinery, cannot but tend to have a bad effect on the quality of cotton turned out. We regard the existence of these small unregulated factories as a serious evil and are of opinion that all ginneries and presses should not only be brought under the operations of the Factory Act, irrespective of the number of work people they employ, but should also be required to take out licenses in accordance with the scheme we have put forward.

228. It will be observed that amongst the conditions on which licenses would be issued is one that the provisions of the Factory Act should be observed. Breaches of that Act would, of course, be punishable under it but we have thought it advisable that this condition should be inserted in the licenses in order to bring home to the factory owner his responsibility in the matter. Breaches of the conditions in regard to the submission of returns, the use of standard weights and correct scales, the maintenance of records, the disposal of seed and the minimum period for working during the year would be followed by the suspension or withdrawal of the license. In regard to the condition that gins should be kept in proper order, we consider that it would be sufficient if the Factory Inspector were to report to the local Committee, when making his annual or other visits to a factory, if he found the condition of the gins unsatisfactory. This would result in consignments of cotton from the ginnery in question being carefully watched and, if it were found that they contained an undue proportion of cut or crushed seed, the license of the ginnery would be withdrawn. We consider that licenses should also be withdrawn in cases in which it is proved that cotton is fraudulently damped, that it contains an undue admixture of seed, that it contains an admixture of waste or that it is "false packed" i.e., contains an excessive amount of foreign substances such as dirt, sand, leaf, etc. We should, perhaps, explicitly state that where cotton damaged by rain or in any other way is plainly marked on the bale as such, no action would be required in regard to it.

229. As regards the procedure which should be followed before a license is withdrawn, it has been our object to avoid putting forward any recommendations which would involve inquisitorial inspection by poorly paid subordinates with its consequent evils. We realize that, in any case, the acceptance of some of our recommendations will entail more work on the Factory Department, which we should be glad to see strengthened, as our enquiries showed that in some provinces many factories are far from thoroughly inspected. Our aim has been to devise some method of securing the participation of the trade itself in preventing abuses and to avoid making them penal offences, a course

which we feel certain would prove most unsatisfactory. We therefore propose that action in regard to cotton which has been fraudulently damped, mixed or adulterated in any of the ways mentioned in the preceding paragraph, should only be taken on a complaint from the ultimate user or exporter to the Central Cotton Committee or to the Provincial Committee. The Central or Provincial Committee would require the person complaining to give the marks and numbers on the bales and would then delegate one or more members to examine the bales to ascertain the genuineness of the complaint. The local Committee for the place at which the cotton was ginned or pressed would be requested to enquire further into the matter and to report to the Central or Provincial Committee. The Report of the local Committee and of the Provincial Committee, in cases in which the complaint was made to it, together with the explanation, if any, of the owner of the ginning or pressing factory would be duly considered by the Central Committee, which would recommend to the Local Government the withdrawal of the licenses or the issue of a warning as it thought fit. We recommend this procedure with a view to securing uniformity of treatment and standardization of punishment throughout India. We recognize that it would be difficult, if not impossible, under this procedure, for an English or Continental spinner to obtain redress against a ginning or pressing factory but if unsatisfactory cotton were received by a spinner in England or on the Continent, the fault would lie with his exporter or agent who would obviously have failed to examine the cotton before export and to exercise his right of complaint to the Central or Provincial Committee. We realise that the withdrawal of a license is a serious penalty. It should, therefore, we consider, only be recommended after one or two warnings have failed to produce the desired improvement unless the circumstances of the case are so special as to leave no option but to withdraw the license at once. It would be for the Central Committee to decide whether a warning would meet the case or whether the withdrawal of the license should be recommended. It may be urged that, under this system, the owner of a ginning or pressing factory working on commission might be penalized for malpractices for which he was not really responsible and which might, in fact, have taken place after the cotton had left his hands. We do not think it likely that cases of this kind will occur but should they do so, we would point out that one warning should be sufficient to prevent the factory owner from having any further dealings with a merchant in regard to whose cotton there had been complaints except under stringent guarantees against their recurrence. Complaints in regard to the continued non-submission of returns or the submission of incorrect returns would likewise be investigated by the local Committee at the request of the Central Committee on the complaint of the authority to whom the returns should have been submitted. As regards the term for which the withdrawal of the license should be in force, it should ordinarily be for the remainder of the ginning or pressing season though, in extreme cases, the license might be suspended for a further year or period of years. Where a factory is found working without having taken a license or continuing to work after its license has been withdrawn, we consider that a penalty

should be imposed by legislation, say of Rs. 5 for each gin in the case of a ginning factory and Rs. 100 in the case of a pressing factory for every day on which work is carried on without a license.

We would add that the condition in regard to the control of seed issuing from ginning factories which we have suggested above has been adopted from the regulations in force in Egypt. New factories erected in the Punjab since March, 1917, have to conform to certain conditions laid down by the Punjab Government. We would also mention that damping of cotton has already been made a penal offence in Hyderabad and that the licensing of ginning factories under certain conditions is already an accomplished fact in the Gwalior State. This and the evidence submitted to us by the official witnesses from the States we visited shows that there is reason to believe that the Governments of those States will be willing to follow the lines we have suggested for British Territory. The hope that they will find themselves able to do so is one of the reasons why we have not recommended, as was suggested to us by several witnesses, that the Central Cotton Committee should be the licensing authority but only that action in regard to licensing should be taken on its recommendation.

230. One of the arguments which has been adduced both by witnesses appearing before us and in past discussions on the subject against the introduction of such a system of control of ginning and pressing factories as we have proposed is that the history of the Bombay Cotton Frauds Act. shows that it is not likely to prove successful. A brief reference to the history of that Act should, therefore, perhaps be made. It is unnecessary to enter into the history of the early legislation in regard to the adulteration of cotton in Bombay and it will be sufficient to say that the first two Acts dealing with the subject were Regulation III of 1829, which did not apply to Bombay City itself, and Act XV of 1851 (India) in which the provisions of the Regulation were applied with some modification to the Islands of Bombay and Colaba. In 1863, as the result of the enquiries of a Commission on the subject, the Government of Bombay passed the much more stringent Act of 1863 (Bombay) which, in addition to prescribing penalties (fine or imprisonment or both as well as confiscation) for fraudulent adulteration and deterioration of cotton (but not for "false packing") and the fraudulent sale or offer for sale of adulterated or deteriorated cotton, also prescribed a penalty for the offer of adulterated cotton for pressing. It enacted that all cotton presses should be licensed, that a new license should be required in the case of alteration or removal of a press, that every licensee of a press should use a distinguishing name or mark and that any failure to obey the provisions of the Act in these respects should be punishable with fine. It further provided for the appointment of Inspectors of Cotton who were given powers of access at all times to ginning and pressing factories and also powers to seize and detain all cotton in respect of which any offence under the Act appeared to have been committed. The cost of the establishment thus created was to be met by a fee of four annas levied

on every bale of cotton exported from any place in Bombay to any place outside British India. The fee was reduced to three annas a bale in 1865, and to two annas in 1872.

The Act aroused strong opposition amongst mercantile bodies and others whose protests were mainly directed against the provisions in regard to establishment and the export tax. The objections to inspections and domiciliary visits were forcibly pointed out and it was argued that the Act had been passed in the special circumstances arising out of the American war and therefore to meet a state of affairs which no longer existed, owing to the great improvement in Indian cotton, which was largely due to the introduction of a mutual allowance system. In consequence of these representations, a new Act VII of 1878 (Bombay) was passed, the most important change in which was the abolition of all personal penalties, *i.e.*, imprisonment and fine, for adulterating cotton or selling adulterated cotton and the substitution or confiscation of such cotton as was shown to the satisfaction of a magistrate to have been fraudulently or dishonestly adulterated. The provisions regarding the licensing of presses and the use of press marks, to which no objection had been taken, remained. The Act, however, met with no better favour than had its predecessor from the mercantile community in Bombay, whose opposition was reinforced by that of the Chambers of Commerce of Liverpool and Manchester. It was consequently repealed in 1881. It is important to mention that, within three years of its repeal, the Liverpool Chamber of Commerce memorialized the Secretary of State with a view to the re-enactment of the special penal provisions against fraud and adulteration, on the ground that the adulteration of Indian cotton was every year becoming more extensive, more systematic and more skilful.

It will be seen that the repeal of the Bombay Cotton Frauds Act was mainly due to the objections taken to the establishments of inspectors and the special tax which was levied to enable its provisions to be carried out. In the scheme we have outlined, we do not propose the revival of a special Cotton Department nor do we suggest the imposition of a special tax for the purpose of meeting any expenditure involved by our recommendations under this head. Further, we do not propose that malpractices in regard to the damping, mixing or adulteration of cotton should be made the subject of criminal cases. The only penalty we have suggested for such practices is the withdrawal of the license of the factory in which they are carried on and this will only be inflicted on the recommendation of a Committee, on which the trade itself will be largely represented. Our object has been to secure the co-operation of the trade in the prevention of malpractices to the greatest extent possible. In these circumstances, we are of opinion that our proposals are not open to any of the objections urged against past legislation. Circumstances have changed considerably since 1881 and we would again point to the strong body of opinion both in India and in England in favour of a system of licensing ginning and pressing factories.

231. In most of the cotton centres, the ginning and pressing factories have combined to form pools, a system which is in many ways objectionable and prejudicial to the interests of the cultivator. Under this system, the procedure is, as a rule, for the same charge for ginning and pressing to be levied by all the factories participating in the pool. A certain proportion of this charge, considered sufficient to cover the actual cost of ginning and pressing, is retained by each factory and the remainder is paid into the pool and is divided at the end of the season *pro rata* to the number of gins or presses owned by the various members. In some cases, pools have resulted from changes in economic conditions. The opening of new railways or roads and consequent improvements in communication have left ginning and pressing centres high and dry, with an inadequate supply of cotton to keep the gins and presses fully employed. The factories, in order to protect themselves against cut-throat competition and to secure a reasonable return on the capital invested in them, therefore formed themselves into a pool. But, both in these cases and in others, in which pools were formed without such good reasons, the result has frequently been that new ginning and pressing factories which have never worked and which were never intended to work have been erected in places already over-supplied. The only object with which they were erected was to share in the profits of the pool and the mere threat to start working has been sufficient to secure the entry of their owners into the pool. In consequence, rates have been forced up to a level which can only be regarded as excessive, to the detriment of the cultivator who is unable to stand out against a monopoly. Whilst in most districts, the ginning and pressing charges, including the contribution to the pool, average about Rs. 5 to Rs. 6 for ginning and the same amount for pressing a bale of 400 pounds of lint, in some cases we found rates as high as Rs. 11 or Rs. 12 for each process.

It is difficult to suggest any suitable remedy for the evils resulting from pools. We cannot, on principle, recommend an obvious solution which would be the fixing of rates by Government. We look forward to a great increase in the number of gineries run by co-operative societies but this will be a very slow process. In the meantime, the proposal we have put forward above that no license should be granted to a ginning or pressing factory, which does not undertake to work for at least eight weeks in the year, unless prevented by causes beyond the control of its owner, should have a beneficial effect in preventing the erection of gins or presses merely for the purpose of sharing in the profits of a pool. We would further suggest that, in districts where there are more ginning or pressing factories than are necessary for dealing with a bumper crop, the local authorities might induce the owners of some of the factories to move them to localities, where they would be of real use, by the offer of Government land on easy terms. We consider that, where members of a pool in any district keep one or more factories closed, without adequate justification, no night shift working should be allowed in any circumstances. Night shifts are allowed under the Factory Act with the permission of the Factory Inspector. In the cases specified, such

permission should invariably be refused. We do not see why labour should be asked to work at night when there are factories existing which, if worked during the day-time, can deal with the crop of the season, without resorting to a night-shift.

232. In connexion with the subject of ginning, we should perhaps mention that the bulk of the ginning factories in India are fitted with Platt's single and double roller gins. There are, however, a few saw gins in the Dharwar American tract and two experimental sets in the Punjab and Sind. The saw gin undoubtedly turns out a cleaner class of cotton than the roller gin and it has the further advantage of saving much of the manual labour required during the ginning process owing to the fact that it is usually fitted with a suction feeding arrangement for *kapas* and an exhaust delivery of lint in a "condenser" form. In view of these advantages, we made extensive enquiries as to the possibility of using these gins on a larger scale in India. The evidence we obtained on the point went to show that, owing to a tendency to cut the staple of the cotton, saw gins were not suitable for dealing with any Indian cotton. We consider it desirable, however, that the question should be further investigated, especially in the tracts in which cotton of American types is grown. We understand that one of the leading exporting firms has taken the matter up and the results of its experiments should enable a definite conclusion to be arrived at in regard to it. It should, in our opinion, be feasible to devise an automatic system of feeding with *kapas*, removing lint and collecting seed which would be capable of application to single and double roller gins. The matter is one of some importance in view of the increasing cost of labour everywhere and its scarcity in tracts such as Sind. We would, therefore, recommend that it be brought to the notice of the leading makers of gins and consider that this might well be done by the Central Cotton Committee, the formation of which we have suggested below.

233. Our recommendations in this Chapter may be summarized as follows:—

- (1) Cotton markets on the Berar system should be established in other provinces as soon as possible, more especially in the cotton tracts of the Bombay Presidency, except Sind, the Madras Presidency except the Coconada tract, and the Punjab Canal Colonies.
- (2) Cotton prices should be published in up-country markets, subject to certain limitations.
- (3) The dates of the payment of instalments of land revenue in the cotton-growing tracts of the Bombay Presidency, except Sind and Khandesh, should be altered.
- (4) Efforts should be made to expand the numbers and activities of co-operative sale societies, such societies, at the outset, to be initiated and supervised by the Agricultural Department.
- (5) Auction sales, conducted by Government agency, are advisable in the case of new varieties up to a certain stage, after

which the work should be handed over to other agencies, subject to suitable arrangements being made in regard to the control of seed.

- (6) The formation of buying agencies should be left to the trade.
- (7) There should be no interference with the practice of forward sales by the cultivator or middleman or with the purchase of cotton "forward" by mills or exporters in the ordinary course of trade.
- (8) The weights used in all cotton markets and ginning and pressing factories throughout India should be standardized on the basis of a cotton maund of 28 pounds.
- (9) The Agricultural Department should undertake experiments with the cleaner picking of cotton, in order to enable definite conclusions to be arrived at in regard to the value of cotton so picked.
- (10) The transport of cotton waste or fly by rail or sea, except from one mill to another or to a port for shipment outside India should be totally prohibited.
- (11) The transport of loose *kapas* or lint in *docras* or of half pressed or full pressed bales by rail, except to *bonā file* consumers and to ports for disposal there or shipment outside India, should also be prohibited except, in certain cases, under license.
- (12) All ginning and pressing factories should be licensed, a preliminary to the issue of licenses being the assignment to all factories of distinctive numbers and marks which would enable the cotton dealt with in them to be traced.
- (13) Licenses should only be granted on certain conditions and should be withdrawn for breach of those conditions and on proof of such malpractices as damping, mixing and adulteration.
- (14) All ginning and pressing factories should be brought under the operation of the Factory Act and required to take out licenses, irrespective of the number of hands employed.
- (15) Licenses should be withdrawn by the Local Government on the recommendation of the Central Committee, after the procedure laid down has been followed.
- (16) Suitable penalties should be imposed in the case of factories working without taking out a license or after a license has been withdrawn.
- (17) Where ginning and pressing pools exist, and, in consequence, there are more factories than are really required, concessions in regard to the grant of land should be offered to induce the surplus factories to move to other localities. In such circumstances, no night shift working should be permitted.
- (18) The question of the possibility of using saw gins for Indian cotton as well as of improving roller gins should be further investigated.

CHAPTER XVII.

Statistical.

234. Amongst the questions referred to us for report was the possibility of improving the accuracy of the cotton forecasts and generally of making the statistical information published by Government of greater use to the cotton trade. In addition to the cotton forecast and the information contained in such publications as the "Agricultural statistics of India," the "Commercial statistics of India," the "Estimates of area and yield of the principal crops in India" and the "Annual statement of foreign sea-borne trade and navigation," the Department of Statistics issues three publications specially devoted to cotton, "Cotton press returns," issued fortnightly, "Statistics of cotton spinning and weaving in Indian mills," issued monthly and a "List of cotton pressing factories and cotton spinning mills in India," issued yearly.

235. It was only in regard to the cotton forecast and the press returns that we received any criticisms or suggestions and we shall therefore confine ourselves to these. Taking first the cotton forecast, we found the general consensus of opinion, both of witnesses from the trade and from the Agricultural Department, to be that the figures of area given in it were, on the whole, very fairly accurate. Opinion was almost equally unanimous that little or no reliance could be placed upon the figures of outturn, which are of considerably more importance from the point of view of the trade. Very few witnesses had, however, any suggestions to offer as to the steps which should be taken to obtain greater accuracy. That the complaints in regard to the inaccuracy of the figures published in the forecasts are justified is clear from a statement submitted to us by the Director of Statistics, which shews that the trade figures obtained by adding the net exports to the consumption in and outside mills were, on the average of the ten years ending 1916-17, 9·6 per cent. in excess of the official estimate of outturn. Although the trade figures include an estimate for "extra mill" consumption which is merely conventional, they represent as near an approach to actuals as can be obtained and it is evident therefore that the cotton crop is persistently underestimated. The main reason for this is a well-known one and is common to all crops. It is the ingrained pessimism of the Indian cultivators and village officers, as a result of which it is very rarely that a normal crop is reported. A subsidiary reason is the difficulty of determining the true normal, which is of rather a visionary character. Various attempts have been made to define it from time to time but it cannot be said that any of the

definitions have been such as to be easily comprehensible by the primary reporting agency, the village officer. Further confusion arises from the fact that, although practically all over India the outturn is estimated in annas, a certain number of annas being taken to represent the normal outturn and the outturn of the year under report being estimated at so many annas higher or lower than the normal, the number of annas taken to represent a normal outturn is not the same everywhere but varies between twelve and sixteen annas. This difficulty is met, though only partially, by not using the anna notation in the published forecasts, where it is replaced by the American notation, 100 being taken to represent a normal crop and the estimated outturn being stated as a percentage of that crop, the conversion of the anna estimate into the percentage estimate being made by the district officer or by the provincial authority.

236. Whilst we feel that considerable improvements can be effected in the present system and have put forward proposals on the subject below, we consider that it should be recognized that really accurate returns both of cotton and other crops cannot be obtained without a substantial increase of staff of possibly a different character from any which has hitherto been employed for the purpose. In this connexion, it has been suggested to us that a Crop Reporting Board on the lines of that of the United States should be established in India. A brief description of the methods of crop reporting adopted in the United States may, therefore, be of interest. The data on which the crop reports issued by the Bureau of Crop Estimates in the United States are based are obtained through a field service consisting of a corps of paid State field agents and crop specialists, and a large body of voluntary crop reporters consisting of the following classes:—county reporters, township reporters, individual farmers and several lists of reporters for special enquiries. The field service consists of trained field agents, each of whom is assigned to a single State or group of smaller States. These agents, who are whole-time officers, travel through their State during the crop season, personally inspect crop areas, confer with the State and local authorities, private and commercial agencies and others interested in crop reporting work. Each agent supplements his own observations with reports from a corps of selected crop reporters in his territory who report directly to him and are wholly independent of the crop reporters who report direct to the Bureau. In addition to the regular State field agents, the Bureau has a small force of crop specialists, who specialize on particular crops and travel throughout the entire region in which the crop to which they are assigned is grown. These crop specialists also have selected lists of crop correspondents who report directly to them. Both the State field agents and the crop specialists are appointed by the Civil Service Commission after a rigid competitive examination. As regards voluntary crop reporters, there are about 2,800 principal county reporters and 32,000 "township" reporters who report directly to the Bureau at Washington. A large number of individual farmers and planters also report on the results of their own farming operations throughout the year

and valuable data are obtained from 30,000 mills and elevators. It should be mentioned that, owing to the specialized nature of the cotton crop, the reports concerning it are handled separately from the reports on other crops and that, in addition to the regular estimates of the ordinary reporting authorities, the Bureau obtains reports on acreage, yields, ginning percentage, etc., from many thousands of special reporters who are intimately concerned with the crop, including practically all the ginner. The reports received from the different classes of individual correspondents are tabulated and compiled by the Bureau and the figure for each State is computed. The work of making the final crop estimates culminates at sessions of the Crop Reporting Board which consists of five members. The Chairman is the Chief of the Bureau and the members are selected from the statisticians and officials of the Bureau and the field agents and crop specialists, the latter being summoned to Washington for the purpose. The personnel of the board is changed every month. Elaborate precautions are taken to ensure that the reports issued by the Board are made available simultaneously throughout the United States and that the information contained in them does not leak out prematurely.

237. Whilst we are of opinion that the system in force in the United States presents an ideal which should eventually be worked up to in India, we consider that, in the present state of development of this country and of its finances, it is out of the question to hand over the work of crop reporting to a separate agency created for the purpose. Nor are we in favour of the establishment of a Crop Reporting Board. With the exception of the Director of Statistics, the members of such a Board could only be Directors of Agriculture or of Land Records, whose other duties would not allow them to spare the time to attend meetings and who would not be acquainted with crop conditions throughout the whole of the cotton tracts, as is the case with the members of the Board in the United States. In these circumstances any proposals in regard to the removal of defects in the present system must be based on the supposition that the existing agency will continue and it is from that point of view that we shall discuss possible improvements.

238. The Director of Statistics has submitted to us various suggestions in regard to the improvement of the figures of outturn with which we are, in the main, in agreement. Some of these were also placed before us by other witnesses. In the first place, we consider it desirable that the work of submitting estimates of outturn should be everywhere handed over, as soon as possible, to the Agricultural Department. The figures of areas with which, as we have already stated, there is little fault to be found, must continue to be supplied by the Revenue Department, but we do not regard this agency as a suitable one for estimating outturns, work which can only be properly done by men who have had practical training in

agriculture. As the Agricultural Department expands, there should be no difficulty in regard to its taking the work over completely. In the meantime, a beginning might be made in such tracts as the Canal Colonies of the Punjab where its organisation is already sufficient for this purpose. We would, however, point out that it is most undesirable that the time and energies of the subordinate staff should be frittered away in making crop cutting experiments, as appears to be the case to, an undesirable extent in some provinces, especially in Burma. We find it difficult to understand the object of these experiments in that province as we are informed that they are not utilized at present for the purpose of forecasts, which are based on the data collected by Settlement Officers.

239. It has been suggested that more use should be made of the results obtained on the Government experimental farms in connection with forecasts. A word of caution is, however, necessary in this respect. The cultivation on the Government farms is, in most cases, much superior to that on the lands of the average cultivator, and the outturn on the farms is not a safe guide, therefore, to the average outturn over a large tract. But the results obtained are undoubtedly of great value in making a comparison between the outturn of one season and another and, in the case of cotton, in ascertaining the ginning percentage of the different varieties.

(ii) **Greater use of results obtained on Government farms.**

In this connexion, we would mention that in Madras, Bombay, Bihar and Orissa, the United Provinces and Assam, crop forecasts are received by the Department of Statistics from the Director of Agriculture, who, in the case of the two provinces last mentioned, is also Director of Land Records. In Burma, the forecasts are sent to the Director of Statistics by the Commissioner of Settlements and Land Records, whilst, in the Central Provinces and the Punjab, they are sent by the Director of Land Records, except in the case of the final wheat forecast which is submitted by the Director of Agriculture. In view of our recommendations above, we are of opinion that in all provinces which have a Director of Agriculture, the work of submitting crop forecasts to the Department of Statistics should be undertaken by him.

240. As regards the information submitted by the primary reporting agencies, we are in entire agreement with the suggestion of the Director of Statistics that measures should be taken to impress the meaning of the term "normal" and its equivalent in annas on the minds of these agencies. We understand that the trade in general regards sixteen annas as representing a normal crop but that, in most provinces, a twelve annas crop is considered a normal crop. In these circumstances, we recommend that the latter standard should be maintained. We see no reason why it should not be adopted throughout India, but if there are any tracts in which it is difficult to bring it into force owing to the backwardness of the reporting agency, it would probably be better, in the interests of accuracy, to continue the existing system, a correcting factor being supplied by the Provincial Director. In view of the varying significance attaching to

(iii) **Estimates submitted by primary reporting agencies.**

the term "normal," we are of opinion that the possibility of substituting a quantitative estimate of outturn, *i.e.*, an estimate in maunds per acre for the anna estimate should be considered. If the submission of outturns is handed over to the Agricultural Department, this should present no difficulty. In any case, in order to eliminate chances of error, we consider that the primary reporting agency should invariably report the yield of cotton in terms of *kapas* whenever a quantitative estimate is given and that the necessary conversion into cleaned cotton should only be made in the office of the Provincial Director. In the same way, conversion from the anna estimate into the American notation should only be made in the office of the Provincial Director. One point which it is desirable should be impressed on the primary reporting agency is the necessity for the exercise of great care in estimating the outturn when cotton is grown mixed with other crops in the same field. Faulty estimating in this case has undoubtedly contributed largely to the persistent underestimating of the cotton crop in the past. Although experience shows that cotton grown mixed with other crops sometimes yields nearly as much as the pure crop, especially when the other crops are harvested before it, the outturn is usually estimated on the basis of the proportion of the total area actually occupied by it.

241. We are emphatically of opinion that sufficient use has not hitherto been made of non-official agencies

(iv) **Assistance from non-official agencies.** which are often in a position to render valuable assistance in arriving at a correct estimate of the crop. Our enquiries showed that many of the leading firms connected with the cotton trade make estimates of their own for particular tracts which are found to be more in accordance with the actual facts than is the official estimate. We were given to understand that such firms would be willing to render assistance in making the latter more accurate than is the case at present, especially if an arrangement were made under which these estimates could be sent direct to the Director of Statistics instead of to the Provincial Director in order to prevent the possibility of the information contained in them leaking out, a point in regard to which some apprehension is entertained. Only in two provinces does any attempt appear to have been made to make use of non-official reporting agencies and only in those to a very limited extent. We consider this system capable of very great expansion. In addition to the large firms, there are, in all provinces, many landholders, both large and small, who would gladly co-operate with the Agricultural Department in this matter and would be able to supply valuable and accurate information. We therefore recommend that efforts should be made in all provinces to secure as large a body of non-official crop reporters as possible. The forms sent to such reporters should be printed in English and the vernacular and the reports should be submitted direct to the Provincial Directors. Another non-official agency of which use should be made is the ginning factories. We have dealt with the question of ginning and press returns below and here would only recommend that ginning factories should be encouraged to report at the commencement of each season how the ginning percentage of the crop is working out as compared with other years.

242. We understand that, in most provinces, it is already the practice to check figures of outturn with the statistics of exports, mill consumption and "extra mill" consumption where these are available. We need do no more, therefore, than to call attention to the importance of the latter figures which, as we have already stated, represent as near an approach to actuals as can be obtained. We would also emphasize the importance for the purpose of preparing crop forecasts of exact knowledge of the outturn of the previous year. It is absolutely essential for purposes of comparison that the final estimates of the crop of the year previous to the one under report should be finally *corrected* estimates. If the submission of the fortnightly ginning and press returns is made compulsory as we have suggested in paragraph 245, they should also provide a valuable check on the forecast estimates.

243. Finally, we would emphasize the necessity for a close and careful check of the returns in the office of the Provincial Director of Agriculture or Land Records who is responsible for them as far as his province is concerned. Our enquiries showed that in provinces in which the Director has sufficient time to take a personal interest in the matter, the forecast estimates are much more accurate than in provinces in which his other duties do not permit him to devote any attention to statistical work. In the latter case, it has not infrequently happened that obviously incorrect estimates have been submitted, which have had to be corrected by the Director of Statistics in the light of other information. It is obvious that, in such cases, there is every chance of the occurrence of mistakes which the Department of Statistics may not be in a position to discover. We would therefore recommend that, in provinces where the

(vii) **Appointment of Assistant Directors of Agriculture for statistical work.**

Director of Agriculture is unable to devote sufficient time to statistical work, an officer of the standing of an Assistant Director of Agriculture should be attached to his office, whose primary duty should be the compilation of the provincial forecasts not only of cotton but also of other crops. Such an officer would make frequent tours throughout the season during which the crop was on the ground and would also make it his business to keep in touch with firms connected with the trade and with the non-official reporting agencies we have suggested above. He would also be in close touch with the Central and Provincial Committees and the local sub-committees, the formation of which we have recommended in Chapter XIX, who would be in a position to give him valuable information. We consider that the work in connexion with forecasts is of sufficient importance to justify the creation of an appointment of this character in provinces in which the Director of Agriculture has his hand too full to pay sufficient attention to them. There should be no difficulty in utilizing the services of such an officer as we have suggested on other work but, in course of time, as his work on forecasts developed, he would become a whole-time officer. An appointment of this nature would be a first and important step in the evolution of a crop reporting agency such as exists in the United States.

Number and date of forecasts.

244. At present, the prescribed dates for the publication of the cotton forecasts are :—

	Provincial.	All India.
First forecast	August 10th.	August 15th.
Second „	October 10th	October 15th.
Third „	December 10th.	December 15th.
Fourth „	February 10th.	February 15th.

These dates were fixed by the Government of India in 1905. The only criticism we received in regard to them, which we consider it necessary to discuss, was that the date of the final forecast is much too early to enable the greater part of the Madras crop to be included in it. It was pointed out that a large part of the cotton crop in Tinnevely is often not even sown when the final estimates are prepared. When the dates were prescribed, it was suggested, in the case of Madras, that when any part of the area sown or of the outturn could not be estimated by the 10th February, a note to that effect should be made in the February return. In view of the great importance of the Madras crop to consumers of long staple cotton, we do not consider this sufficient and recommend that a fifth and final forecast should be issued in April, in which full information in regard to that crop could be included. It was suggested by several witnesses that it would be an advantage to the trade if a monthly forecast of the cotton crop were issued. We are unable to support this proposal as we are unwilling to make any recommendations which would add to the work of the Revenue or Agricultural Departments in this respect. Another argument against it is that the Native States, in which, as has already been mentioned, one-third of the cotton grown in India is produced, already find the forecasts submitted somewhat burdensome and would be much averse from such an increase in their number. We consider an improvement in the accuracy of the forecasts a much more important matter than an increase in their number and we trust that the recommendations we have made in this respect as regards British Territory will also commend themselves to the Darbars of Native States.

245. The Department of Statistics issues fortnightly a return showing the quantity of cotton pressed in the pressing factories and of unpressed cotton received in the spinning mills during the fortnight together with progressive totals up to the end of the fortnight. These returns should be of value as a means of checking the estimates of outturn given in the cotton forecast. Their submission is, however, purely voluntary at present and the result is that they are very far from complete. Out of a total number of 750 presses and 245 mills for the whole of India, the maximum numbers from which returns were received during the pressing season of 1916-17 were 271 and 115, respectively. The smallness of the number of presses from which returns are obtained is undoubtedly due to the fact that many of them do not work, owing to a short crop, or the existence of pools, as a result of which they

remain closed for a whole season. But that the returns are seriously incomplete is clearly brought out by figures supplied to us by the Director of Statistics which show that the total quantity of cotton pressed in pressing factories and of unpressed cotton received in spinning mills up to August 31st, 1917, according to the returns from British Territory was 2,757,876 bales only out of a total crop, according to the revised estimate, of 3,547,000 bales and, in Native States, 103,621 bales out of a total crop of 955,000 bales. The witnesses we examined on this point were unanimously and emphatically of opinion that the press returns as at present submitted are worse than useless and that, unless their submission is made compulsory by legislation, they should be abolished. On the other hand, there was a consensus of opinion that, if the returns were complete and were published more promptly than at present, they would be of great use to the trade. We see no reason why the submission of returns of cotton ginned and pressed should not be made compulsory both in the case of ginning and of pressing factories. We consider it desirable that returns should be submitted by ginning factories as well as by pressing factories. The returns from the one class of factories would be a valuable means of check on those submitted by the other. The desirability of a return of unpressed cotton received by spinning mills arises from the fact that all the cotton which is ginned is not pressed, some of it going direct to mills. The mill return, therefore, supplements the press return. It should, however, be mentioned that unpressed cotton not only goes direct to spinning mills but is also used for 'extra mill' consumption whilst an appreciable amount of hand-ginned cotton does not pass through the ordinary ginneries but goes direct to presses. As we have already pointed out in Chapter XVI, proper records of cotton ginned and pressed are maintained by all reputable factories and it is therefore no hardship to require the submission of returns by such factories. We have, therefore, proposed that one of the conditions under which a license should be issued to a ginning or pressing factory should be that the owner of the factory should undertake to keep a complete daily record of all the cotton ginned or pressed in the factory and that failure to keep such a record or to submit regularly and punctually such returns as may be prescribed by Government should be followed by cancellation of the license. This should, in our opinion, be sufficient to secure the submission of complete returns from ginning and pressing factories.

In view of the small amount of unginned cotton which reaches the mills and of the slight inconvenience involved in reporting the same, we would leave it to the good sense of mill owners to submit these returns so as to ensure greater accuracy for the statistics as a whole.

We are of opinion that, as at present, provincial totals only should be given and that the particulars submitted by the individual mills should not be published but should be treated as confidential.

246. At present, the duty of collecting the returns from presses and mills in Native States is undertaken by the
Returns for Native States. Bombay Chamber of Commerce. We consider

it desirable that the Chamber should be relieved of it and that steps should be taken either to procure the returns through the authorities of the States, or with their assistance, to secure that they are sent direct to the Department of Statistics. We understand that it has already been decided at the Conference of Ruling Chiefs held at Delhi in November, 1917, that Darbars should be invited to supply the returns and that steps are being taken to carry out this decision. Both in the case of Native States and British Territory, we think it would lead to the more prompt publication of the returns if they were sent direct by ginning and pressing factories and by mills to the Department of Statistics. At present, the returns from British Territory are received by that Department from the Directors of Agriculture or of Land Records in a consolidated form. Whilst the procedure we propose would entail some additional work on the Department of Statistics on which the work of compiling the consolidated return would be thrown, it would meet the complaints we received that the returns are issued, as a rule, very long after the period to which they relate.

247. As regards the form of the return, we are of opinion that it might be improved by the addition of a column showing the number of ginneries, presses, or mills, closed or working during the period to which it relates and that it would be an advantage if a monthly or quarterly abstract table were published on postcards as in the United States. We see no objection to the substitution of monthly for half-monthly returns in any province or Native States, in which this is considered desirable.

248. In conclusion, we would mention that we understand that the staff of office of the Director of Statistics which deals with agricultural statistics consists of five clerks only. In view of the importance of this branch of the work of the Department and of the fact that some of the proposals we have made in this chapter will throw additional work on it, we are of opinion that it should be considerably strengthened.

249. Our recommendations in this Chapter may be summarized as follows :—

In regard to the improvement of the cotton forecasts :—

- (1) The work of submitting estimates of outturn should everywhere be handed over to the Agricultural Department as soon as possible, a beginning being made, in the meantime, in tracts in which the Department is sufficiently organized for the purpose.
- (2) The results obtained on Government farms should be utilized more largely than at present, especially for purposes of comparison with previous years and for ascertaining ginning percentages.

- (3) Measures should be taken to impress upon primary reporting agencies the meaning of the term "normal" and its equivalent in annas. A twelve-anna crop should everywhere be regarded as representing a normal crop, unless there are special reasons to the contrary.
- (4) The desirability of substituting a quantitative estimate for the anna estimate should be considered.
- (5) The yield of cotton should invariably be reported by primary reporting agencies in terms of *kapas*, the necessary conversion into terms of ginned cotton and of the anna estimate into American notation being made in the office of the Provincial Director.
- (6) Special care should be taken in estimating the outturn of cotton when grown with other crops.
- (7) More use should be made in regard to figures of outturn of non-official agencies, such as large firms, large and small land-holders, and ginning factories.
- (8) The figures of outturn should be checked with statistics of export, mill consumption and extra-factory consumption. Care should be taken to see that the comparison with the outturn of the previous year is made on the basis of the finally corrected estimates for the latter.
- (9) There should be a careful check of the returns in the office of the Director of Agriculture, an officer of the standing of an Assistant Director of Agriculture being attached to it for work connected with forecasts in provinces in which the Director has not sufficient time to devote to them.
- (10) A fifth and final forecast of the cotton crop should be issued in April to enable information in regard to the Madras crop to be included in it.

In regard to the press returns :—

- (11) The submission of returns of cotton ginned and pressed by ginning and pressing factories should be made compulsory by legislation, the penalty to be the withdrawal of the license of the factory.
- (12) The returns both from British Territory and Native States should be sent direct to the Department of Statistics.
- (13) The form of the return should be improved in certain respects.

In regard to the office of the Director of Statistics :—

- (14) The section of the office which deals with agricultural statistics should be considerably strengthened.

CHAPTER XVIII.

Establishment of a Central Cotton Trade Association in Bombay.*

250. Our attention has been specially directed to the fact that there is not at present in Bombay or elsewhere in India any central body standing in the same relation to the cotton trade of India as the Liverpool Cotton Association does to the cotton trade of Lancashire. In case it may be thought that we are going beyond our terms of reference in making any recommendations under this head, we would point out that the subject has a most important bearing on the reputation of Indian cotton in the world's markets. Its consequent reaction on the position of the cultivator of cotton is, in our opinion, sufficient justification for the inclusion of recommendations in regard to it in our Report.

There are, at present, in Bombay seven distinct bodies representing different branches of the cotton trade. They are :—

- (1) The Bombay Cotton Trade Association, Limited.
- (2) The Bombay Cotton Exchange, Limited.
- (3) The Bombay Millowners' Association.
- (4) The Cotton Brokers' Association.
- (5) The Marwari Chamber of Commerce.
- (6) The Cotton Merchants' and Muccadums' Association.
- (7) The Japanese Cotton Shippers' Association.

None of these bodies can be regarded as representative of the trade as a whole and, at times, the interests of some of them come into conflict with those of others. Bombay has, again, no such properly regulated "future" market and no such system of weekly settlements as exist in Liverpool. The result is, as we shall show below and as recent events have proved, that speculation is rife in the Bombay cotton markets to a degree which can only be regarded as highly undesirable. The principal varieties in which it is carried on under the terms of "future contracts" are the following :—

Fully good machine ginned Bengals for 25th January delivery.
Fully good machine ginned Khandesh for 25th January delivery.
Fine Khamgaon Akola, fair staple, for 25th January delivery.
Fine or good machine ginned Broach for 25th April delivery.
Good machine ginned Westerns 25th May delivery.

* This chapter, which deals with the conditions existing in the Bombay Cotton Market in April, 1918, was submitted to the Government of India in May, 1918, in advance of the remainder of the Report.

As there is no clearing house and no weekly settlement in Bombay, the result of the present system is that any speculator, who may or may not be in the cotton trade, can gamble in paper contracts only for a whole year without handling any actual cotton. Thus, to take an extreme case, he could, on the 26th April in any year, commence trading in good Broach for delivery on the 25th April of the following year, acting either as a "bull" or a "bear" and could stand to lose as much as fifty lakhs of rupees or more, no control being exercised over his transactions in any way during that period, owing to the fact that settlement only takes place once a year on the dates mentioned above. Such transactions are opposed to the whole idea of "future" markets, as understood all the world over. Future markets, especially those in Liverpool and New York, are primarily intended to facilitate legitimate trade, and operations on them are controlled, in Liverpool,

Future markets in Liverpool and New York.

by a system of weekly settlements and in New York, by one of daily settlements. The object of a future market, as understood in these important centres, is to enable a trader to provide himself with a necessary "hedge" for his transactions. Under this system, a spinner or manufacturer, who has sold yarn or cloth ahead, buys cotton at a fixed price for delivery at a future date so as to cover his sales in order to protect himself against a rise in the market. Obviously, he does not need to buy the cotton until he actually requires it for use. In certain cases, it may not be possible for him to buy "spot" or "ready" cotton and, even if it were, it would mean locking up working capital, which could be employed much more profitably otherwise. On the other hand, a cotton merchant or grower may have cotton on his hands which he is unable to sell at once, in which case he is able to protect himself against the possibility of the market falling by selling "futures" in the "future" market. These are perfectly legitimate trade practices and it was to facilitate them that future markets were instituted. It was, however, soon found that the existence of such markets was taken advantage of by speculators for their own purposes and it was therefore considered necessary, both in Liverpool and New York, to put some check on the operations of persons who bought and sold "futures" for no genuine trade purpose but merely to secure the gain in differences. Such speculators were frequently men entirely without means, such as petty brokers and clerks, who never saw or handled a bale of cotton. In these circumstances, clearing houses were established, both in Liverpool and New York, for the purpose of settling differences for "futures" once a week in Liverpool and daily in New York, the object of this step being to prevent speculators from overstepping the limits of their finances by compelling them to pay differences in cash. The attempts which were made both in Liverpool and New York to corner a particular grade of cotton were met by making the contract for "Middling Uplands" which is the standard for both markets, as wide as possible, delivery of any of the seventeen grades from "good ordinary white" to "fair" being allowed. As the difference between these two qualities has been fixed at 385 points in New York, this prevents any one grade being concerned.

It will be understood from this brief description that transactions in "futures" are very strictly controlled in New York and Liverpool by the system of daily or weekly settlements and by a classification sufficiently wide to enable any grade to be tendered against a contract. There is no control of this nature in Bombay. There is no daily or weekly settlement there and in the case of all the five distinct classes of cotton in which transactions take place, no grade can be tendered against a future contract except the one grade of the particular class on which the contract was based. This enables a speculator, operating on a sufficiently large scale, to corner the market in respect of the growth of any particular district in which the crop may be short. The result, as we have said above, may be wild speculation which it is impossible to check, ending in a crisis such as that which occurred in Bombay in April, 1918.

251. Speculative transactions of the character described are not the only ones carried on in India. There are **Kutchha khandi markets.** markets in Calcutta, Indore, Amraoti, Bikanir and also in Bombay itself where speculative transactions in what are known as *kutchha khandis*, "*kutchha* Americans" or "single and double options" take place on a very large scale, purely on the basis of differences to be paid or received, there being no intention of actual delivery. The operators, in this case also, have frequently no real connexion with the trade. We are of opinion that the speculative transactions in such *kutchha khandi* markets are nothing but gambling pure and simple and should be entirely prohibited.

252. Sufficient has, we think, been said to show the necessity for the exercise of some control over the "futures" market of Bombay. We are of opinion that the time has arrived for the establishment in Bombay under a Royal Charter of a central body, similar to the Liverpool Cotton Association, to control the trade. This body, which might be known as the East India Cotton Association, should take the place of the seven different associations at present existing, the different interests concerned being represented on it. As in New York and Liverpool it should establish a proper basis of classes of cotton for "future" contracts by fixing the number of grades which may be tendered under each. It should license brokers and commission houses and all contracts should be declared illegal unless made through a broker or commission house so licensed and in accordance with the rules and regulations of the Association. Finally it should establish a clearing house for settlements at least weekly.

253. An able scheme for the establishment of a clearing house in Bombay was placed before us by Mr. Noel **Mr. Wilkinson's scheme.** Wilkinson, Secretary of the Bombay Cotton Trade Association. In our opinion, it does not, however, go far enough as it does not provide for different grades being tenderable under each class of cotton allowed for future contracts.

254. It is now a matter of common knowledge that the Bombay cotton trade itself is unanimously and strongly in favour of the formation of an Association on the lines we have proposed. We would here mention that we have every reason to believe that the section of the Lancashire trade which deals in Indian cotton would also welcome it. We understand that there is a feeling in Lancashire that there is not sufficient mutual knowledge between Bombay and Liverpool and that this not infrequently operates to the advantage of those who ship cotton which is not up to standard. The result is to confirm the view taken in many quarters in Lancashire of the unsatisfactory character of Indian cotton. If the cotton trade in Bombay were controlled by one Association only, the Liverpool Cotton Association would be able to enter into mutual arrangements with it calculated to put a stop to practices such as that just mentioned. The effect of this in removing the unfavourable impression of Indian cotton entertained in Lancashire could not fail to be entirely beneficial, especially when combined with the improvement in the marketing of Indian cotton which should result from the adoption of the recommendations we have made in the preceding chapters. Spinners and manufacturers of cotton throughout the Empire would undoubtedly turn their attention more largely to Indian cotton than has hitherto been the case, and this would result in better prices being obtained for it to the advantage of the cultivator and the prosperity of the country.

255. The formation of such an Association as we have proposed above is a highly technical matter and it is not possible on the information before us to deal with it in detail. We consider the question one of some urgency in view of the consensus of opinion as to the desirability of preventing a recurrence of the conditions which prevailed in Bombay in the early part of 1918. In these circumstances, and in the hope that such a scheme will prove acceptable to the various bodies concerned, we have requested one of our members, Mr. N. N. Wadia, on his return to England, to prepare a full scheme in consultation with the Directors of the Liverpool Cotton Association and, if possible, with Mr. N. S. Glazebrook. Mr. Glazebrook has been nominated to the Empire Cotton Committee both by the Bombay Chamber of Commerce and the Bombay Cotton Trade Association, of which latter body he was chairman for many years. We understood that he was formerly a large exporter of cotton from Bombay to the Continent and that since his retirement from Bombay he has been a member of the Liverpool Cotton Association. He has thus a very intimate acquaintance with the working of both the Liverpool and Bombay markets.*

* Mr. Wadia has prepared a scheme which is at present under the consideration of the Government of India.

256. In this connexion, it has been represented to us that there is at present no inducement to a dealer to tender better cotton than the grade he has agreed to deliver as, under the rules of the Bombay Cotton Trade Association, if the cotton comes

"Mutual allowance" clauses and appointment of arbitrators.

to arbitration, he is not allowed any "points on," i.e., he is not given any premium for better quality, whilst he is penalized if the quality tendered is inferior. The rules of the Bremen Exchange contain, as an alternative in the form of contract, a "mutual allowance" clause under which East Indian cotton can be bought and sold, if mutually agreed upon between the buyer and the seller. A mutual allowance clause is also included among the alternative conditions in the form of contract on which Indian cotton is sold in Liverpool. Under this clause, if a consignment is slightly above standard, the seller can claim an allowance which is agreed upon between him and the buyer at the time the contract is made. Before the war, this allowance was almost invariably one-eighth of a penny per pound, but, owing to the recent advance in the price of cotton, it is now usually one farthing per pound. If the cotton is below standard or, in technical language, is more than one-eighth of a penny or one farthing "off," as may be agreed upon between the buyer and the seller, the former has the option of total rejection.

We understand also that, on the Bremen Exchange, the arbitrators are full time officials appointed by the Directors of the Exchange and are not permitted to have any dealings in cotton. In Liverpool and Bombay, arbitration is carried out by members of the respective Associations, who, though they have no direct interest in the transaction under arbitration, are merchants or brokers connected with the cotton trade. The evidence we have received in regard to these two points does not justify us in making specific recommendations but we consider that they should be given due consideration in drawing up the scheme we have outlined above.

257. The system under which Indian cotton is at present classified for trade purposes is based on the name of the districts in which the cotton is grown and frequently on that of the railway stations in those districts. Particular districts and stations therefore get a good or bad reputation in the market or are known as producing a particular class of cotton. In consequence, it frequently happens that if a short staple cotton district produces cotton of better staple in limited quantities, such cotton fails to obtain a price justified by its intrinsic value. Another result of the present system, to which we have already referred, is that cotton of an inferior quality is raised to a station the cotton of which has a better reputation and commands a better price. The cotton is then rebooked to its ultimate destination, its owner hoping in this way to obtain a higher price than he would if it were booked direct from its station of origin. We consider that the present system is very unsatisfactory as it attaches too much importance to the name of the station and too little to the character of the staple and the grade

Trade classification of cotton.

of the cotton, *i.e.*, to its intrinsic value. As cotton for export is always sold on types representing a certain grade of cleanliness and colour and a certain length and fineness of staple, it has been suggested that it would be advantageous to the trade if the present system were abolished and all cotton were bought and sold on that basis. This would, however, mean such a complete reversal of a trade practice of very long standing that we are doubtful about its feasibility in present conditions. A difficulty which stands in the way of the sale of cotton under a standard name instead of under the name of a station is that the same variety of cotton, when grown in different districts under different climatic conditions, is of very varying quality. Thus *karun ganni* cotton grown in the Coimbatore district of Madras is inferior in quality to that grown in Tinnevely whilst Cambodia grown in the Dharwar district of Bombay is in altogether a different class from that grown in Coimbatore. The prohibition of the transport of cotton by rail, except to *bonâ fide* consumers or to ports, should go a long way towards securing that the cotton exported from a particular station is actually produced in the neighbourhood of that station and should therefore make the name of the station of more real importance than is the case at present. We are unable to suggest any other remedy, in existing circumstances, but we consider that, if the Cotton Association, the establishment of which we have recommended above, becomes an accomplished fact, it should take up the question of devising some better system of classification than that which is now adopted. It is possible that with a further extension of the practice of purchasing cotton through their own agents up-country, which is now fairly generally followed by the Bombay mills, the undue importance attached to the names of stations, amounting almost to a fetish, will disappear in the ordinary course of trade.

258. Our recommendations in this Chapter may be summarized as *Summary.* follows :—

- (1) One Central Association to be known as the East India Cotton Association should take the place of the seven distinct bodies which at present control the cotton trade in Bombay. This Association should establish a proper basis of classes of cotton for “future” contracts, should license brokers and commissioned houses and should establish a clearing house for settlements at least weekly. The question of including in the scheme for such an Association, which we have requested Mr. Wadia to draw up, provisions for a “mutual allowance” system on the lines of that of the Bremen Exchange and of the appointment of official arbitrators should be carefully considered.
- (2) All speculative transactions in *kutchā khandis*, “*kutchā Americans*” or “single and double options” should be entirely prohibited.
- (3) The East India Cotton Association, when formed, should take up the question of devising some better methods of classification than that at present adopted.

CHAPTER XIX.

Formation of a Central Cotton Committee.

259. The lack of organization of the cotton trade and of co-operation between it and the Agricultural Departments was a point which was brought prominently to our notice in the course of our enquiries. There is no one body which can be regarded a representative of all trade interests and such control as is exercised by Chambers of Commerce or other important associations is of a very haphazard and indefinite character. In the previous chapter, we have suggested measures for the organisation of the cotton trade in Bombay, which is by far its most important centre in India, and we consider that once the East India Cotton Association has been established there, such functions as the control of the future market, arbitration and the fixing of prices of various grades of cotton should be left entirely to it and that it will not be necessary for Government to interfere in these matters. We consider, however, that something more than this is wanted and that a further organization, less formal and more elastic than we have recommended for Bombay itself, is required to co-ordinate the work of the various Agricultural Departments and to bring the Agricultural Department as a whole into closer touch with the trade. Complaints of lack of touch between the Agricultural Departments of the various provinces in matters relating to cotton and between the Department and the trade were made to us by several witnesses and there is no doubt that members of the Agricultural Service working on cotton in one province frequently do not know what developments are in progress in other provinces. Efforts have been made to bridge these gaps, in some cases, by sending officers of the Department of one province to tour in another and, in others, by making Directors of Agriculture honorary members of Chambers of Commerce but these are unsatisfactory expedients and we are of opinion that the only way in which the difficulties which exist at present can be overcome is the establishment of a central body for the whole of India, on which the trade and the Agricultural Departments could meet on equal terms and to which the Government of India, Local Governments, the Agricultural Department and the trade could all look for authoritative advice on all matters relating to cotton. The constitution of such a body and the functions which should be assigned to it are matters to which we have devoted earnest thought. It will perhaps be more convenient if we first state the specific proposals we make on these points and then proceed to explain them in detail.

260. We recommend that a strong permanent Committee, to be known as the "Central Cotton Committee," should be constituted with headquarters in Bombay. This Committee should be composed of officials and non-officials. The official representatives on it would be :—

- (i) The Agricultural Adviser to the Government of India, who would be President.
- (ii) A representative of the Agricultural Department, who should preferably be an expert working on cotton, from each of the following provinces :—
 - (a) The Punjab.
 - (b) The United Provinces.
 - (c) The Central Provinces and Berar.
 - (d) Bombay.
 - (e) Sind (if the Agricultural Department in that province is separated from that of Bombay).
 - (f) Madras.
- (iii) The Director General of Commercial Intelligence.
- (iv) The Director of Statistics.

The non-official representatives on the Committee would be :—

- (i) A representative of each of the following bodies :—
 - (a) The East India Cotton Association, if established in accordance with the recommendations we have made in the preceding chapter, or failing that, the Bombay Cotton Trade Association.
 - (b) The Bombay Millowners' Association.
 - (c) The Bombay Chamber of Commerce.
 - (d) The Ahmedabad Millowners' Association.
 - (e) The Karachi Chamber of Commerce.
 - (f) The Madras Chamber of Commerce.
 - (g) The Tuticorin Chamber of Commerce.
 - (h) The Cawnpore Chamber of Commerce.
- (ii) A representative of the Central Provinces.
- (iii) A representative of Lancashire.

As regards the last two representatives, we would explain that, as there is no Chamber of Commerce or similar body in the Central Provinces which can be regarded as representative of the cotton trade, we consider that the interests of the trade in those provinces should be represented on the Committee by a leading manufacturer or ginner who would be nominated to it by the Local Administration. If thought desirable, a similar procedure might be adopted in the case of the Punjab, though, in view of the close connexion between the cotton trade in the Punjab and Karachi, we are of opinion that the presence of a representative of the Karachi Chamber of Commerce on the Committee is sufficient. We are of opinion that it is of the greatest importance that Lancashire should be represented on the Committee by a representative,

who might be nominated jointly by the Liverpool Cotton Association and the Employers and Employees Associations. The duties of the Lancashire member of the Committee would not occupy his whole time and it would, in our opinion, be in the interests both of the Lancashire and Indian cotton trade if he could be deputed to represent Lancashire interests generally in India. He might be able to render valuable assistance in promoting the extension of new varieties by attending auction sales and making purchases on behalf of the interests represented by him. This, however, would obviously be a matter for decision by the bodies by which he was nominated.

In view of the important part which co-operation can and undoubtedly will play in promoting the growth of better cotton in India and in bringing about an improvement in marketing, we are of opinion that it is desirable that the Co-operative Department should be represented on the Committee. We would lay down no hard and fast rule as to whether the representative should be an official or a non-official but consider that the appointment would most suitably be made by the Government of India. It will be seen that we have provided no direct representative of the cultivating classes on the Committee. We do not consider that, in present conditions, this is practicable and are of opinion that their interests can safely be entrusted to the officers of the Agricultural Department who will serve on it. Nor have we provided for representatives from Native States as this hardly falls within our province. We think it, however, eminently desirable that the co-operation of Native States in this matter, as in regard to all the other general questions with which we have dealt should be secured, if possible, in view of the fact already mentioned more than once, that one-third of the cotton grown in India is produced in Native States. We are therefore of opinion that the Hyderabad and Baroda States should each be invited to nominate a representative and that, if it can be arranged, the Central India and Rajputana States should have a joint representative.

261. For reasons which we have explained below, we consider that the functions of the Committee should be almost entirely advisory and we would define them as follows :—

- Functions of the Committee.**
- (a) It should advise both the Government of India and Local Governments in regard to any particular questions of cotton policy referred to it.
 - (b) It would recommend both to Government and the trade such measures as appeared to it suitable for safeguarding the existing areas of long staple cotton in the various provinces where these appeared to be endangered as well as for promoting and extending the cultivation of long staple cotton in new areas such as Sind and parts of the Punjab.
 - (c) It would bring to the notice of Government and the trade any changes in the conditions of the cotton growing tracts which may occur from time to time and suggest suitable measures to meet them.

- (d) It would be consulted by Government in regard to legislation proposed on any matters connected with cotton. It would also be consulted in respect of any rules framed under any legislation in regard to such matters both by the Government of India or Local Governments.
- (e) In conjunction with the East India Cotton Association, the establishment of which we have dealt with in the previous chapter, it would deal with the question of the trade classifications of the different varieties of cotton.
- (f) It would assist the Agricultural Departments of the various provinces to obtain authoritative valuations of new varieties of cotton and to get accurate spinning tests carried out.
- (g) It would keep in close touch with the Provincial and local Committees the formation of which we have suggested below, and would especially render them assistance, if required, in regard to the marketing of small quantities of new varieties.
- (h) It would make recommendations in regard to possible improvements in the forecasts and statistics relating to cotton. The statistical work in connection with cotton, such as the compilation and issue of forecasts, of ginning and pressing returns, and of figures relating to the movement of cotton, especially of shipment and local mill consumption, might, eventually, be handed over entirely to it.
- (i) It would act as a bureau for the dissemination of information both in regard to the cotton of India and of other countries to Agricultural Departments and the trade generally, in India and throughout the Empire. To enable it to carry out this latter function, it would keep in close touch with the Empire Cotton Growing Committee and would also keep itself informed of developments in the other cotton growing countries of the world.
- (j) One of its most important functions would be to advise Local Governments in regard to the withdrawal of licenses for ginning and pressing factories under the scheme proposed in Chapter XVI.
- (k) Finally, it would publish an annual review of the general cotton position with special reference to the Indian cotton crop. We consider that a useful model for such a review would be the well known publication "Cotton Facts" published by the Shepperson Publishing Company of New York.

262. Meetings of the Committee would be convened at least once a year or oftener if required. The Committee would probably find it advantageous to devolve some of its functions on sub-committees. To enable it to carry out efficiently the important functions assigned to it, a permanent whole-time Secretary with an adequate staff and suitable offices in Bombay would be required. In view of the fact that the success of the Committee

would depend to a very large extent on the Secretary, we are of opinion that a rate of remuneration should be offered sufficient to attract a man of first class organizing abilities. We also think it most desirable that a Technologist should be attached to the staff, who would have a laboratory in which he could carry out tests on samples sent him by the experts working on cotton in the Provinces and others. Whilst the assistance in regard to tests of samples of cotton which has been rendered to the Agricultural Department by leading mills deserves cordial acknowledgment, we consider that more detailed reports are required than the mills have time to give, and that such mill tests as are necessary after the appointment of a Technologist should be supplementary to the work done by him. The services of such an officer would be of immense value to the Agricultural Department in helping it to arrive at a correct judgment of the value of any new varieties of cotton produced. In present conditions, the great variations in the valuations of the same cotton by different authorities, a point to which we have referred in greater detail in paragraph 267 below render this difficult, if not impossible.

In addition to the work described above, the Technologist could also undertake other lines of research into matters relating to cotton, such, for example, as an investigation into the differences between the fibres of American and Indian yarns. He should also be able to value the different varieties of cotton in such a way as to bring out clearly the real value of staple and of definite increases in its length. The Agricultural Department is, in our opinion, greatly in need of guidance of this kind and its absence largely accounts for the tendency of some workers on cotton to devote attention almost entirely to securing an increase in ginning percentage in preference to an increased length of staple. We have dealt with the question of the cost of the Committee in connection with the general question of the provision of funds to meet the expenditure involved in our recommendations. We consider that the Committee should be given an annual grant of a definite amount sufficient to leave a margin wide enough to permit of an expansion of its activities and have suggested that the amount of the grant should be at least Rs. 2 lakhs per annum. The expenditure of the grant should be left entirely to the discretion of the Committee, which should also have full power in regard to the appointment, etc., of its staff. Whilst the staff would work entirely under the orders of the Committee, we see no objection to the services of officers in Government service being lent to it either permanently or for a term of years, if the posts cannot suitably be filled in any other way.

263. To enable the Central Committee to keep in touch with what is happening in the various provinces, we regard it as necessary that it should work through and with Provincial Committees and local sub-committees. The main functions of these committees would be to provide the Central Committee with full information in regard to all points with which the latter was concerned and to investigate.

Formation of Provincial and Local Committees.

complaints in regard to malpractices in ginning and pressing factories in accordance with the scheme we have proposed in Chapter XVI. The Provincial Committee should, in our opinion, consist of representatives of all branches of the cotton industry as well as of the Agricultural Department. The number of members might vary according to the circumstances of the individual provinces but should not be less than five or more than nine and the Director of Agriculture would be a suitable chairman. The local sub-committees should be formed in suitable centres at the discretion of the Provincial Committee and their composition should follow the lines of the latter, though the number of members would, as a rule, be smaller and should not be less than three or more than five. The Deputy Director of Agriculture should invariably be an ex-officio member of all the sub-committees formed in his circle. Any expenditure incurred by the Provincial or local Committees should be met by a grant from the funds of the Central Committee.

We would add that, in present conditions, the formation of Provincial and local Committees is not necessary in Bihar and Orissa and Assam, where cotton is an unimportant crop and there are no ginning or pressing factories. Although we have not provided for the direct representation of Bengal, the North-West Frontier Province, Ajmer-Merwara and Delhi on the Central Committee, we think it desirable that Provincial Committees, which would work on the same lines as elsewhere, should be formed in those provinces though it may not be necessary to have local sub-committees in addition. In view of the difficulty in regard to distance, we have also not provided for the representation of Burma on the Central Committee though we think that, if the area under cotton in Burma increases, such representation would be advantageous as it would enable the Agricultural Department of that province to get the benefit of Indian experience. We are of opinion that it is desirable that our recommendations in regard to the licensing of gins and presses should apply to Burma and that a Provincial Committee, and if necessary, local sub-committees should be formed but we would recommend that, in the special circumstances of the province, the Provincial Committee should be the body which should deal finally with complaints in regard to malpractices in gins and presses and should, if necessary, recommend the withdrawal of licenses to the Local Government. We see, however, no reason why, in regard to most of the other functions of the Central Committee, the Provincial Committee in Burma should not work in conjunction with it.

As we have already stated, the functions we have assigned to the Central Committee are almost entirely advisory. We should perhaps here mention that we circulated confidentially to Directors of Agriculture, and leading associations and individuals connected with the cotton trade, a scheme differing somewhat in essentials from that outlined above and that the proposals now put forward have been formulated after careful consideration of the valuable criticisms received. It was represented to us in some quarters, to the opinion of which we attach great weight, that the functions of the Committee should be executive

as well as advisory, that it should, in short, dictate the policy which should be followed in the various cotton tracts and should also be the authority in all matters relating to the licensing of gins and presses. Whilst we fully recognize the force of the arguments in support of this view, we have been unable to accept it as we consider that the difficulties in the way of entrusting executive functions to the Central Committee are insuperable. In the first instance, such a course might make it difficult, if not impossible, to secure the co-operation of the Native States in carrying out our recommendations, a point to which, as already stated, we attached very great importance. The second difficulty we feel is that dictation of policy to the various Agricultural Departments by a body outside the province might lead to undesirable friction and that the ultimate authority both in this respect and in regard to the licensing of gins and presses must be the Local Government.

264. Objections have been raised to the establishment of a Central Committee on the ground that it will not have the local knowledge to perform the functions we propose should be entrusted to it and also to its location in Bombay. These we are unable to regard as serious. Bombay is obviously the only possible centre for such a Committee, handling, as it does, about three quarters of the whole of the cotton trade of India and possessing nearly half the looms and spindles in the country, in addition to being the headquarters of the principal exporting houses and ginning firms engaged in the trade. One of the principal objects of the Committee is to ensure close touch between the trade and the Agricultural Departments and nowhere can this be obtained so well as in the principal cotton centre of India. The direct representation of all the cotton growing provinces on the Committee as well as the proposals for the formation of Provincial Committees and of local sub-committees, in our opinion, sufficiently meet the criticism as to lack of local knowledge. We have met the further criticism that the Committee would trench on the functions of the Agricultural Advisor to the Government of India by recommending that that officer should be its President. We would point out that, in any case, owing to his other duties and the distances he has to cover in discharging them, he has not the time to devote to any individual crop, such as cotton, the attention its intrinsic importance may warrant.

265. As we have stated, our main object in proposing the establishment of a Central Cotton Committee is to secure the co-ordination of the work of the provincial Agricultural Departments throughout India and that close co-operation between the trade and the Agricultural Department which is essential in the interests both of the trade and of the cultivator, if the most important industry in India is to develop on sound and healthy lines in all its branches, cultivation, manufacture, and export. The necessity for such co-ordination and

co-operation will be rendered all the more necessary if the large increase in the staff of the provincial Departments of Agriculture which we have recommended is sanctioned. We have in the course of our enquiries, met with numerous cases in which Directors and Deputy Directors of Agriculture, as well as Botanists, working on cotton would have been very glad indeed to have received opinions on the policy they were pursuing. Their complaint has been that they do not know what the trade wants and that, when they produce superior strains of cotton, they are unable to obtain satisfactory guidance as to their real value. The result has been, in some cases, a lack of continuity of policy and, in others, the pursuance of different policies simultaneously by different officers in the same province with consequent dissipation of energy and lack of progress. On the other hand the trade is often in ignorance of what has been done by the Agricultural Departments, especially in provinces in which there are no large commercial centres. It has, for example, been a work of several years to obtain for Punjab 4F variety the recognition in Bombay that the intrinsic merit of the cotton warranted. Nor, as matters are at present, is the trade in a position to bring to the notice of the Agricultural Departments any changes in the conditions in which cotton is picked, ginned or marketed with a view to alteration or improvement. We are of opinion that a central body, constituted as we have suggested, would command the confidence both of the trade and the Agricultural Departments and would remove these obstacles to development.

266. If our recommendations in regard to the formation of a Central

**The Imperial Cotton
Specialist.**

Cotton Committee and an increase in the staff of the provincial Agricultural Departments, especially on the botanical side, are accepted, we consider that the appointment of Imperial Cotton Specialist will cease to be required and recommend its abolition on the retirement of its present holder. At the same time we wish to place on record our sense of the obligation which all botanists working on cotton in India are under to Mr. Gammie for the work he has done in that appointment, especially on the classification of Indian cottons which is now practically complete. The cotton tracts of India are so vast and the problems so numerous and complicated that it is impossible for one man to deal adequately with them even in an advisory capacity and it is for this reason that we have felt that what is required to secure co-ordination and co-operation is not one expert but a body of experts. Mr. Gammie's valuable library and collections could, in due course, be transferred to the Central Cotton Committee.

267. Amongst the functions assigned to the Central Cotton Com-

Trade valuation of samples.

mittee is that of assisting the Agricultural Departments of the various provinces to obtain authoritative valuations of new varieties of cotton and to get accurate spinning tests carried out, and for this purpose amongst others, we have recommended the appointment of a Technologist to its staff. It was

represented to us by several officers of the Agricultural Department that they found considerable difficulty in obtaining valuations of cotton from the trade on which absolute confidence could be placed, owing to the great variations in the valuations made by different firms, associations or mills, whether in Bombay or Lancashire. In some cases in which samples of different varieties of cotton were sent to more than one firm for valuation, the cotton which headed the list in the valuation made by one firm was entered at the bottom or very low down in the list sent by the others. This difficulty is especially felt in the case of new varieties, such as the American varieties in the Punjab or the improved strains evolved by the Bombay and Madras Agricultural Departments on their farms. The result of the variations in the valuations is that the Agricultural Department is left in doubt as to whether a new variety is likely to prove acceptable to the trade and whether, if grown on a commercial scale, it will be taken up by it. Our enquiries on this point show that the reasons why the Agricultural Department has not been able to obtain valuations on which more reliance could be placed, are two in number. In the first place, the samples submitted to the trade for valuation are usually very small, at most only a few pounds. In the second place, the cotton, as a rule, is very carefully picked and is ginned under the close supervision of the Department. It is not surprising in these circumstances, that the valuation of cotton grown on an experimental farm and picked and ginned under optimum conditions should differ considerably from the actual price obtained for the same variety grown on a large scale under ordinary conditions and marketed in the ordinary way. To obviate the disappointment which has not infrequently been caused in the past by the failure of a new variety to come up to the expectations based on a valuation obtained in its early stages, we recommend that, in every case in which the Agricultural Department requires a valuation of any cotton grown by it, it should, in the first instance, send to the Central Cotton Committee, or, until that has been formed to an association of standing such as the Bombay Cotton Trade Association, a sample of not less than twenty pounds of lint for valuation. If the valuation proves satisfactory, it should then grow the cotton on a field scale sufficiently large to give 200 pounds of lint, have it picked under the ordinary agricultural conditions prevailing in the tract in which it is grown and have it ginned and pressed under the commercial conditions prevalent in that tract. The cotton should then be sent to the Central Committee which would arrange with a leading mill to have a proper spinning test with the standard turns per inch not exceeding seventeen turns per inch for 20s. counts to be carried out. We have suggested 200 pounds as it is the smallest quantity which would enable the spinning mill to get four clean laps from the blowroom. If the spinning test proves satisfactory, the Agricultural Department will be able to proceed with confidence to push the new variety. As we have already suggested, it would be one of the duties of the Technologist attached to the Central Committee to explain to the Agricultural Department the exact significance of the valuations and tests carried out.

268. Our recommendations in this Chapter may be summarized as *Summary.* follows :—

- (1) In order to secure co-ordination and co-operation in all matters relating to cotton, a Central Cotton Committee of a permanent character, composed of representatives of the Agricultural and Co-operative Departments, the Director General of Commercial Intelligence, the Director of Statistics and representatives of the trade should be established with headquarters at Bombay. The Agricultural Adviser to the Government of India should be the President of the Committee, the staff of which should include a whole-time Secretary and a Technologist. The main functions of the Committee would be to act as an advisory body to Government and the trade on all matters connected with cotton, including questions relating to legislation and the licensing of ginning and pressing factories, to act as a centre for the dissemination of information regarding cotton and to assist the Agricultural Department, through its Technologist, in obtaining authoritative valuations of new varieties.
- (2) In order to carry out its functions, the Committee would act through and with Provincial Committees and local sub-committees. Such Committees would be formed in all the provinces in which cotton is grown except Bihar and Orissa and Assam. In view of the special circumstances of Burma, the Provincial Committee in that province would be the advisory body in regard to the licensing of ginning and pressing factories.
- (3) The post of Imperial Cotton Specialist will cease to be necessary on the formation of the Central Cotton Committee and should be abolished on the retirement of its present holder.
- (4) Samples of cotton submitted by the Agricultural Department for trade valuation should, in the first instance, be not less than twenty pounds of lint. If the report on these is satisfactory, 200 pounds of the cotton grown on a field scale and handled under ordinary conditions should be sent for a mill test.

CHAPTER XX.

Conclusion.

269. We have divided our report into two parts, the first of which deals with the agricultural and irrigational

Conclusion.

aspects of cotton cultivation and the second with the commercial aspect. But, in conclusion, we wish to emphasize as strongly as possible, that the recommendations in both parts must be treated as an organic whole. It is of little avail if the Agricultural Department evolves pure or improved strains of cotton, increases the outturn by the introduction of improvements in agricultural practices and ensures cleaner methods of picking or if the Irrigation Department provides facilities for the extension of the cultivation of cotton, unless the cotton produced is marketed in a condition which enables it to secure its proper price and unless the cotton trade pays that price for it. We have pointed out that the cotton trade is not in a position to cope with the numerous abuses which have been so detrimental to the reputation of Indian cotton in the past without assistance from Government and that a policy of *laissez faire* in such matters is no longer possible or desirable. The recommendations we have made in the second part of our Report are, therefore, in every way, as important as those in the first part, if a real improvement in Indian cotton is to be obtained. If the proposals we have made in both parts are accepted, the future of Indian cotton will be in the hands of the trade. The fundamental assumption on which we have acted throughout is that there is a genuine demand for long staple Indian cotton and that the trade is willing to pay a sufficient premium for it to make it worth the while of the cultivator to grow it but that there have been various obstacles in the past which have prevented it from doing so. We have submitted proposals which will remove those obstacles and will enable long staple cotton to compete with short staple cotton on its merits. It will, therefore, rest with the cotton trade to convince the cultivator in the only way in which he can be convinced, that long staple cotton pays him better than any other varieties. If it succeeds in doing so, as we trust it will, India will be able to make no mean contribution to the resources of Empire.

J. MACKENNA, *President.*

N. N. WADIA.

F. HODGKINSON.

H. F. ASHTON.

G. S. HENDERSON.

W. ROBERTS.

} *Members.*

F. NOYCE, *Secretary.*

APPENDIX I.

Itinerary of the Indian Cotton Committee.

Lyallpur	October 8th—12th, 1917.
Jhang	„ 13th.
Sargodha	„ 14th and 15th.
Multan	„ 16th and 17th.
Mirpurkhas	„ 19th—21st.
Hyderabad	„ 22nd—24th.
Iqbalnagar	„ 25th.
Montgomery	„ 26th.
Renala Khurd	„ 27th.
Hansi	„ 29th.
Hissar	„ 29th.
Aligarh	„ 30th.
Cawnpore	„ 31st—Nov. 6th.
Jalgaon	November 7th and 8th.
Raipur	„ 9th and 10th.
Nagpur	„ 11th—14th.
Akola	„ 15th—17th.
Khamgaon	„ 18th.
Sehore	„ 19th and 20th.
Ujjain	„ 21st and 22nd.
Indore	„ 23rd—26th.
Poona	December 9th—13th.
Lahore	January 7th—10th, 1918
Lyallpur	„ 11th—16th.
Sukkur	„ 17th.
Nawabshah	„ 18th.
Karachi	„ 19th—23rd.
Bombay	„ 25th—Feb. 3rd.
Viramgam	February 4th.
Ahmadabad	„ 5th—10th.
Broach	„ 11th.
Surat	„ 12th.
Navsari	„ 13th and 14th.
Bijapur	„ 16th and 17th.
Dharwar	„ 18th and 19th.
Hubli	„ 20th and 21st.
Gadag	„ 22nd.
Hagari	„ 23rd.
Raichur	„ 24th—26th.
Nandyal	„ 27th.

untur	February 23th—Mar. 1st
Madras	March 2nd—6th.
Madura	„ 7th and 8th.
Virudupatti	„ 9th.
Koilpatti	„ 10th.
Tuticorin	„ 11th—13th.
Coimbatore	„ 14th—17th.
Calcutta	„ 20th—26th.
Simla	„ 28th.

APPENDIX II.

Statistics of the World's Production and Consumption of Cotton.

TABLE 1.—THE WORLD'S COTTON SUPPLY AND THE BRITISH EMPIRE'S SHARE IN IT.

(Compiled by Professor J. A. Todd, Secretary, Empire Cotton Committee.)

(Based on pre-War figures.)

Grade and quality.	Where grown.	World's crop Bales of 500 lbs.	Empire's share. Bales.	Per cent.
I. Best Sea Island	Islands, South Carolina	8,000	4,000	33
	West Indies	4,000		
		12,000		
II. Sea Islands	Florida and Georgia	70,000	552,000	89
	West Indies	2,000		
		622,000		
Best Egyptian (Sakel, etc.)	Egypt	550,000	760,000	70
		622,000		
		1,085,000		
III. Egyptian	Egypt	700,000	415,000	2·5
	Sudan	20,000		
		16,715,000		
Staple American	Mississippi delta, etc.	200,000	4,500,000	64
	Nyasaland, Uganda, & E. & S. Africa	40,000		
		7,050,000		
Peruvian	Peru	125,000	6,231,000	24·5
		1,800,000		
		25,484,000		
IV. American	United States of America	15,000,000	415,000	2·5
	Mexico	150,000		
	Brazil	300,000		
Russia	Russia	500,000	4,500,000	64
	West Africa	15,000		
	Levant	100,000		
India	India	400,000	6,231,000	24·5
	China and Corea	250,000		
		16,715,000		
V. Indian, etc.	India	4,500,000	4,500,000	64
	Russia	750,000		
	China	1,800,000		
		7,050,000	6,231,000	24·5
		25,484,000		
		25,484,000		

NOTE.—In the case of Egypt, the allocation between Grades II. and III. is based on the most recent figures available.

**TABLE 2.—BALANCE OF PRODUCTION AND CONSUMPTION OF COTTON,
1914—1918.**

(Compiled by Professor Todd.)

	WORLD'S COMMERCIAL CROPS AND MILL CONSUMPTION.				AMERICAN CROP AND WORLD'S CONSUMPTION THEREOF.			
	Mean Crops.	Mean Consumption.	Balance.	Average Price of American, Indian, and Egyptian.	Commercial Crops.	Consumption.	Balance.	Average Price of American.
1904-1905 .	19,648	17,726	+ 1,922	5'66	13,656	12,664	+ 992	4'93
1905-1906 .	17,266	18,214	— 948	6'73	11,443	12,081	— 638	5'94
1906-1907 .	20,815	19,523	+ 1,292	7'21	13,735	13,203	+ 532	6'38
1907-1908 .	17,564	19,393	— 1,829	6'68	11,456	12,112	— 656	6'19
1908-1909 .	20,229	19,828	+ 401	6'29	13,831	13,157	+ 674	5'50
1909-1910 .	17,216	19,148	— 1,932	9'10	10,592	11,754	— 1,162	7'86
1910-1911 .	18,854	20,222	— 1,368	8'54	11,986	12,054	— 68	7'84
1911-1912 .	22,157	21,495	+ 662	7'09	16,108	14,515	+ 1,593	6'09
1912-1913 .	21,503	22,302	— 799	7'57	14,106	14,715	— 609	6'76
1913-1914 .	22,309	23,296	+ 1,013	7'52	14,882	14,541	+ 341	7'26
1914-1915 .	Complete statistics not available.				15,108	13,834	+ 1,274	5'22
1915-1916 .					12,938	14,812	— 1,874	7'51
1916-1917 .					12,941	13,906	— 965	12'33
1917-1918 .					11,907	12,282	— 375	21'68

TABLE 3.—ACREAGE, YIELD AND PRICES OF THE WORLD'S CHIEF CROPS, 1913—19.

(Compiled by Professor Todd.)

Season.	Acreage.	Per cent. on 1913.	Crop.	Yield per acre.	LIVERPOOL PRICES (PENNY PER LB.).		
					Lowest.	Highest.	Average.
<i>American.</i>	<i>Acres.</i>		<i>Bales—500 lbs. approximately.</i>	<i>Bales.</i>	<i>Middling.</i>		
1913-14 . .	37,458,000	—	14,809,968	39	6-20	7-96	7-26
1914-15 . .	37,406,000	100	15,067,247	40	4-25	6-50	5-22
1915-16 . .	32,107,000	86	12,953,450	40	5-34	8-74	7-51
1916-17 . .	36,052,000	96	12,976,000	36	8-12	10-45	12-33
1917-18 . .	34,925,000	93	12,000,000	34	10-90	24-95	21-68
1918-19 . .	37,073,000	99	12,500,000	34	—	—	—
<i>Indian.</i>	<i>Acres.</i>		<i>Bales—400 lbs.</i>	<i>lbs.</i>	<i>No. 1 Fine Oomra.</i>		
1913-14 . .	25,020,000	—	5,065,000	81	4-70	6-56	5-87
1914-15 . .	24,595,000	98	5,209,000	85	3-94	5-00	4-46
1915-16 . .	17,746,000	71	3,738,000	84	4-75	6-90	6-09
1916-17 . .	21,745,000	87	4,502,000	83	7-10	13-30	11-00
1917-18 . .	24,781,000	99	4,036,000	65	15-50	20-36	16-60
1918-19 . .							
<i>Egyptian</i>	<i>Feddans.</i>		<i>Kantars.</i>	<i>lbs.</i>	<i>F. G. F. Brown.</i>		
1913-14 . .	1,723,094	—	7,684,172	444	8-15	10-45	9-44
1914-15 . .	1,755,270	102	6,490,221	369	6-30	8-30	7-34
1915-16 . .	1,186,004	69	4,806,331	406	7-50	11-90	10-42
1916-17 . .	1,655,512	96	5,111,030	310	11-60	31-50	21-56
1917-18 . .	1,677,310	97	6,250,000	357	27-50	32-80*	30-97*
1918-19 . .	1,315,572	76	4,930,000	375	—	—	—

The figures in italics are estimates.

* Sakel.

TABLE 4.—DISTRIBUTION OF THE AMERICAN COTTON CROP.

Taken from the Annual Statement of the American Cotton Crop published by the Liverpool Cotton Association, Ltd.

Years.	DISTRIBUTION IN AVERAGE PERIODS OF FIVE YEARS.						PROPORTIONAL DISTRIBUTION.							
	EXPORT.					Taken by American spinners north and south.	Total Deliveries.	EXPORT.				Taken by American spinners, north and south.	Years.	
	Great Britain.	France.	North Europe.	Other Ports.	TOTAL.			Great Brit- tain.	France.	North Europe.	Other Ports.			TOTAL.
1886-41 .	983,978	324,137	54,113	39,376	1,401,604	268,080	1,669,684	58-94	19-41	3-24	2-36	83-95	16-05	1836-41
1841-46 .	1,229,903	349,203	97,599	94,380	1,771,085	390,324	2,161,409	58-94	16-16	4-51	4-37	81-94	18-06	1841-46
1846-51 .	1,243,622	295,980	112,629	129,007	1,781,238	548,583	2,329,821	53-37	12-70	4-84	5-53	76-44	23-56	1846-51
1851-56 .	1,696,092	422,546	188,886	190,478	2,498,002	720,680	3,218,688	52-70	13-13	5-86	5-91	77-60	22-40	1851-56
1856-61 .	2,020,549	433,141	260,455	189,106	2,953,251	826,825	3,780,076	53-45	12-78	6-89	5-00	78-12	21-88	1856-61
1866-70 .	1,234,359	237,634	144,107	63,034	1,679,134	874,800	2,553,994	48-34	9-30	5-64	2-46	65-74	34-26	1866-70
1870-75 .	1,897,833	261,245	393,696	113,172	2,665,946	1,183,543	3,849,489	49-80	6-79	10-22	2-94	69-25	30-75	1870-75
1875-80 .	2,151,081	447,480	590,521	207,381	3,390,463	1,551,060	4,947,523	43-50	9-06	11-90	4-20	68-66	31-34	1875-80
1880-85 .	2,604,209	450,153	810,112	294,144	4,158,618	1,925,196	6,083,814	42-83	7-40	13-32	4-81	68-36	31-64	1880-85
1885-90 .	2,835,574	436,280	1,004,241	344,083	4,620,178	2,258,127	6,878,305	41-23	6-34	14-60	5-00	67-17	32-83	1885-90
1890-95 .	3,111,785	683,001	1,340,498	502,780	5,583,064	2,758,188	8,346,252	37-28	7-59	16-06	6-02	66-95	33-05	1890-95
1895-1900 .	2,943,375	695,300	1,791,432	823,111	6,253,518	3,410,042	9,663,860	30-46	7-19	18-54	8-52	64-71	35-29	1895-1900
1900-05 .	3,129,382	766,752	2,099,960	883,512	6,579,606	4,319,228	11,198,834	27-94	6-85	18-75	7-89	61-43	38-57	1900-05
1905-10 .	3,126,804	924,499	2,373,267	983,414	7,407,984	4,989,034	12,397,018	25-22	7-46	19-14	7-93	59-75	40-25	1905-10
1910-15 .	3,705,399	977,255	2,651,879	1,453,941	8,788,474	5,769,240	14,557,714	25-45	6-72	18-22	9-98	60-37	39-63	1910-15
1915-18 .	2,807,571	861,124	131,380	1,659,301	5,259,376	7,611,894	12,871,270	20-25	6-69	1-02	12-90	40-86	59-14	1915-18
(3 years.)														(3 years.)

TABLE 5.—WORLD'S ACTIVE COTTON SPINDLES, 1900 and 1914.

(Compilation of the United States Bureau of the Census Bulletin 131.)

Country.	Active Cotton Spindles.	
	1914.	1900.
United States		
Cotton-growing States	12,711,000	4,368,000
All other States	19,396,000	15,104,000
TOTAL	32,107,000	19,472 000
Europe—		
United Kingdom	56,300,000	45,500,000
Germany	11,550,000	8,000,000
Russia	9,160,000	7,500,000
France	7,410,000	5,500,000
Austria-Hungary	4,970,000	3,300,000
Italy	4,620,000	1,940,000
Spain	2,210,000	2,615,000
Belgium	1,530,000	920,000
Switzerland	1,380,000	1,550,000
Sweden	560,000	360,000
Portugal	480,000	230,000
Netherlands	500,000	300,000
Denmark	90,000	40,000
Norway	65,000	35,000
Other European Countries	200,000	130,000
India	6,500,000	4,945,000
Japan	2,750,000	1,274,000
China	1,000,000	550,000
Brazil	1,250,000	450,000
Canada	965,000	550,000
All other countries	800,000	520,000
TOTAL	146,397,000	105,681,000

APPENDIX III.

Statement showing the progress made by auction sales of American cotton in the Punjab.

Year.	Area under American cotton.	Area under 4F.	Number of sales.	Approximate quantity of <i>kapas</i> sold in maunds.	PREMIUM PER MAUND OF <i>kapas</i> ON		Value of <i>kapas</i> sold.
					<i>Deshi.</i>	Other American.	
	Acres.	Acres.			Rs. A. P.	Rs. A. P.	Rs.
1905-08	Under 1,000	<i>Nil.</i>	Sold by private treaty		..	..	..
1908-09	1,000 to 1,500	..	2	A few hundred maunds.	1 5 0 to 1 9 0	1 5 0 to 1 9 0	5,000
1909-10	3,000	..	2				
1910-11	6,000	..	2		1 6 0 to 1 8 0	1 6 0 to 1 8 0	Approximately Rs. 7,000
1911-12	9,000	..	No sales held. Factory owners gave Re. 1 over price of <i>deshi</i> in the open market.				
1912-13	15,000	..					
1913-14	30,000	80	1	950	2 13 0	1 0 0 to 1 8 0	9,000
1914-15	60,000	3,000	2	5,200	3 13 0	1 13 0	25,000
1915-16	65,000	9,000	8	8,000	3 5 0	1 8 0	80,000
1916-17	125,000	30,000	9	48,000	4 0 0 to 7 0 0	1 8 0 to 4 0 0	576,000
1917-18	276,000	125,000	12	100,000	4 0 0 to 5 0 0	1 8 0 to 2 8 0	1,800,000
			2 private sales.	22,000	3 8 0	1 8 0	440,000

APPENDIX IV.

Details of a typical auction sale of American cotton in the Punjab held at Lyallpur, January 13th, 1918.

(i) *Copy of notification under which the sale was held.*

AUCTION SALES OF AMERICAN COTTON, 1917-18.

Auction sales of American cotton will be held by the Punjab Agricultural Department at the following places on the dates shown against each :—

Colony.	Place.	Date.
Lower Bari Doab . . .	Montgomery . . .	22nd November 1917.
Ditto	Mian Chanu . . .	24th " 1917.
Ditto	Chichawatni . . .	28th " 1917.
Ditto	Jahanian	2nd December 1917.
Ditto	Okara	6th " 1917.
Lower Chenab	Lyallpur	11th " 1917.
Ditto	Sangla Hill	15th " 1917.
Lower Jhelum	Sargodha	17th " 1917.
Ditto	Bhalwal	20th " 1917.
Lower Chenab	Jaranwala	21st " 1917.
Ditto	Jhang	3rd January 1918.
Ditto	Gojra	7th " 1918.
Ditto	Tandlianwala . . .	11th " 1918.

Each auction will commence at noon save that at Mian Chanu which will commence at 4 P.M.: no cart will be allowed to enter the auction which has not arrived at the sale ground before 9 A.M. on the day of sale. Any person who wishes can bring his cotton for sale at these auctions, subject to the following conditions, which will be binding on both buyer and seller :—

- (1) The auctions will be held on common ground and the cotton weighed there, unless otherwise decided.
- (2) The *arti* of the seller will supply the scales, weights, and men for weighing purposes; the buyer will supply men for taking down the cotton from the scales. The scales used will be the iron scales, with pointer, as commonly used in most *mandis*. Either the buyer or a responsible and authorized representative must be present throughout the weighing.
- (3) Commission agents will charge nothing from the buyer.
- (4) The seller will be responsible for all costs up to, and including, the putting of the *kapas* on the scales. After this the buyer is responsible.
- (5) Carts will be classified by the Agricultural Department before the sale starts and weighments must follow the order of arrival of carts as far as possible. The cotton will be sold as it is on the basis of classification. A seller is not at liberty to refuse to accept the classification of his cotton by the Department, or to withdraw his cart from the sale on the ground that he considers the amount bid for it insufficient, or for any other reason. Every seller will be given a *parcha*, showing the class in

which his cotton has been put, and will affix his signature or thumb-mark to an agreement to the effect that he agrees to this and every other condition of this sale.

- (6) The Agricultural Department reserve the right to refuse to accept any bid, even the highest. The Department will only accept bids from either actual buyers themselves or their responsible and authorized representatives; and reserve the right to refuse bids from persons who are not known to be either or their authorized representatives.
- (7) The buyer will be expected to weigh the whole of the *kapas* on the day of sale. In the event of delay considered by the Agricultural Department to be avoidable penalties not exceeding the following may be charged by order of the Department:—

On any cotton left unweighed after the first day and weighed before the evening of the second day one anna per maund, for the third and subsequent days an extra three annas per maund per day.

- (8) In the event of rain, hail, or other natural calamity after sale and before weighing or in the event of any disputes arising out of the conditions or the interpretation of the conditions of the sale, the Agricultural Officer in charge will be sole arbitrator and his decision shall be final.
- (9) After the auction, the buyer shall deposit Re. 0-4-0 a maund earnest money with the Agricultural Department, to be held in trust for the seller.
- (10) The buyer must pay in full for all cotton bought by him and delivered to him within three days of the weighment. The buyer will be charged three pies per maund daily for all *kapas* unpaid for at the end of three days.
- (11) Wherever *dami* or any other tax on the cotton is due to the Municipality it will be paid by the buyer but he is not liable to any charges on account of any *mandi* charities or other funds. The buyer will get one *pao* per maund, i.e., 40½ seers, in place of 40 seers in weighment. Thus, the buyer will pay for, say, 10 maunds at Rs. 10 the amount of Rs. 100 in full, which the zamindar will receive after the following deductions for *tulai* and *arat*, etc. In the Chenab Canal Colony the deductions will amount to Re. 1-6-0 per 100 and in the Lower Bari Doab Canal Colony to Re. 1-9-0 per 100. The *arti* is responsible for prompt payment to the seller.
- (12) Should the Agricultural Department require the seed of the cotton sold, the buyer must arrange for separate storage of the *kapas* and must gin the *kapas* without passing through the opener and set and clean the machines to the satisfaction of the Department. A premium which will be announced at the time of the sale will be paid for seed thus required. The seed must be delivered at the town where the auction was held.
- (13) No cotton will be sold by sample at these auctions unless the sample has been duly taken and passed as correct by the officers of the Agricultural Department. For this a charge of one per cent. on the price realized at the sale will be made, to be paid by the seller. Notice must be given by sellers desiring to take advantage of this section at least fifteen days before the auction at which it is desired to sell the cotton to the Professor of Agriculture, Lyallpur, in the case of auctions to be held in the Lower Chenab and Lower Bari Doab Colonies and to the Deputy Director of Agriculture, Gurdaspur, in the case of auctions to be held in the Lower Jhelum Colony, to enable the necessary arrangements to be made. The Agricultural Department reserves to itself the right to decline to take samples of any lot it wishes.
- (14) The auction sale shall be subject to the conditions set out above and all bids given, and all bids received, at the auction shall be considered as given and received, subject to the above conditions.

(ii) Details of the cotton sold.

Class.	Description.	Quantity.	Price of seed paid.	Price realized per maund of kapas.	Buyer.	REMARKS.
		Mds. Srs. Ch.	Rs. A. P.	Rs. A. P.		
A ₁	4F American pure meant for seed.	1,638 35 12	3 12 0	23 1 0	Messrs. Forbes, Forbes Campbell and Company, Bombay.	Price of <i>deshi</i> at Lyallpur on 13th January Rs. 16-6 per maund.
A ₂	*Pure 4F but not for seed.	1,355 13 8	3 10 0	22 12 0	Messrs. Tata Sons and Company, Bombay.	Price of American at Lyallpur on 13th January Rs. 20 to 21-2 (latter price for six carts only.
B	4F American with a mixture of up to one per cent. of <i>deshi</i> .	5,568 24 14	..	21 7 0	Messrs. Tata Sons and Company, Bombay.	Price of Broach at Bombay on 12th January Rs. 19 per maund.
C	4F American with a mixture of up to five per cent. of <i>deshi</i> .	1,195 19 4	..	20 12 0	Messrs. Forbes, Forbes Campbell and Company, Bombay.	Price of Punjab American at Bombay on 12th January Rs. 20-4 per maund.
D	Other American varieties pure.	743 27 8	..	21 4 0	Messrs. Tata Sons and Company, Bombay	Price of cotton seed in the bazar on 13th January Rs. 3-8-6 per maund.
E	Other American varieties with a mixture of up to five per cent. of <i>deshi</i> .	3,758 29 10	..	20 11 0	Messrs. Tata Sons and Company, Messrs. Forbes, Forbes Campbell and Company.	Actual quotations for Punjab American and Broach at Bombay on 12th January :—
	TOTAL	14,170 30 8				Rs. Punjab American 650 Broach . . 610

* Seed was taken from this also at Lyallpur.

APPENDIX V.

Report on the auction sale of American cotton held by the Okara Zamindars' Co-operative Society on 22nd January 1918.

The Okara Zamindars' Co-operative Society which has been established to assist its members to sell their agricultural produce to the best advantage, held its first auction at its Agency at Okara in the Lower Bari Doab Canal Colony on the 22nd January, when some 11,500 maunds of American cotton was put up for sale.

Owing to the unfavourable nature of the weather during the flowering season, the yield this year has not exceeded an eight anna average. Moreover, the members of the Society had already sold the bulk of their crop at an auction held by the Agricultural Department in December, so that the amount of cotton offered for sale at this auction was comparatively small.

The cotton which was pure 4F American *kapas* (fifty per cent. first and last pickings and fifty per cent. second pickings) was put up for sale in three lots as follows :—

	Maunds.
Lot A	1,000
Lot B	9,525
Lot C	1,000

Lots A and C, respectively, were the property of Colonel Cole and Chowdrie Jehangir Khan, and Lot B was contributed by five different estates, which had combined to sell together, namely : Major D. Vanrenen, Military Oat-Hay Farm, Sirdar Mala Singh, 10th Lancers Horse Run, and Dr. Ghulam Kadir.

The cotton was sold on sample, each member producing and being individually responsible for his sample. After the sale, each sample had to be sealed and deposited at the Agency.

The conditions of the sale were roughly as follows :—

- (a) Weighment to take place at the godowns of the respective estates.
- (b) Delivery to be taken before 31st March.
- (c) Payment on delivery.
- (d) Cartage free to Okara or railway.
- (e) The Agricultural Department to arbitrate in case of dispute.

There were only three buyers present to bid, namely :—

- (a) Messrs. Tata and Sons, Millowners, Bombay.
- (b) Messrs. Kirpa Ram Brij Lal, Proprietors, Ginning Factory, Okara.
- (c) Messrs. Gulzari Mal Ram Chand, Proprietors, Ginning Factory, Pattoki.

All three lots were secured by the Proprietors of the Ginning Factories at Okara and Pattoki. The prices realized were Rs. 20 per maund for each of the lots A and C and Rs. 21 for the big lot B.

The local market rate on the same day was Rs. 18 per maund and the Bombay rate as telegraphed to the Agency by Messrs. P. Chrystal and Company, Bombay, was Rs. 610 for good Broach (equivalent to Rs. 670 for American).

Having regard to the Bombay rate, the prices realized were not good but the restriction of goods traffic undoubtedly affected the bidding, since the representatives of Messrs. Tata and Sons, who would have had to rail the cotton to Lyallpur or Raewind to gin, stated that, if wagons had been available, he would have bid up to Rs. 23 a maund delivered at either of those places. However as the sellers,

in case of railway difficulties, had offered to store the cotton at their estates on behalf of the buyers until freight became available, the millowners' representatives should not have given way so soon to the local ginners who are merely middlemen. It is the middlemen that our Society desires, if possible, to eliminate, since we are confident that if we as producers can get into direct dealings with the Bombay manufacturers, mutual advantages must inevitably result.

Next year it is expected that our Society will have some 100,000 maunds of pure American cotton for sale, and it is hoped that Bombay manufacturers will make a special effort to secure this by sending representatives to our auctions at Okara.

Sirdar Labh Singh of the Agricultural Department, who was present at our auction on the 22nd instant, afforded much assistance, and our Society desires to express its deep appreciation of the support and help it has received throughout from the Agricultural Department.

OKARA ;

The 22nd January 1918.

E. H. COLE, *Colonel,*

D. VANRENEN, *Major,*

for the Okara Zamindars' Co-operative Society.

APPENDIX VI.

(i) Berar Cotton and Grain Markets Law.

GOVERNMENT OF INDIA.

FOREIGN DEPARTMENT.

Notification No. 1727-I.B., dated Simla, the 6th May 1897.

Whereas it has been customary in the Hyderabad Assigned Districts for the Government to open markets and bazaars for the sale of agricultural produce, to arrange for the conservancy and management thereof, to levy fees therein, and to provide for the collection and disposal of the fees levied as aforesaid ;

And whereas it is expedient to continue the custom aforesaid :

In exercise of the powers conferred by Sections 4 and 5 of the Foreign Jurisdiction and Extradition Act (XXI of 1879) and of all other powers enabling him in this behalf, the Governor-General in Council is pleased to issue the following orders :—

1. (1) These orders may be called the Berar Cotton and Grain Markets Law, 1897, and are hereinafter referred to as “ this Title and commencement. Law.”

(2) This Law shall come into force at once.

2. The Resident may, by notification in the *Hyderabad Residency Orders*, declare that any place, the property of the Government or of the public or of a Municipal Committee or District Board, is a market or bazaar for the sale of agricultural produce generally, or for the sale of a particular class or classes of agricultural produce, and may from time to time amend, vary or rescind any such notification.

*3. (1) Such committee or person as may from time to time be appointed for the purpose of carrying out this Law may, in the case of any officer or servant of the Government employed in connection with a market or bazaar—

(a) where his services are wholly lent to such committee or person, subscribe for his pension or gratuity and leave allowances in accordance with any regulations of the Government for the time being in force relating to such pension or gratuity and leave allowances ; and,

(b) where he devotes only a part of his time to the performance of duties in behalf of such committee or person, contribute to his pension or gratuity and leave allowances in such proportion as the Resident may determine.

(2) Any such committee or person may, in the case of any officer or servant not being an officer or servant of the Government—

(a) grant him leave allowances and, where his monthly pay does not exceed ten rupees, a gratuity ; and,

(b) where such committee or person is empowered in this behalf by the Resident, (i) subscribe in his behalf for his pension or gratuity and leave allowances in accordance with any regulations of the Government for the time being in force relating to such pension or gratuity and leave allowances ; or

* This section was added by Foreign Department Notification No. 3101-I.B., dated 25th July 1902

(ii) purchase for him from the Government or otherwise an annuity on his retirement :

Provided that no pension, gratuity, leave allowances or annuity shall exceed the sum to which, in accordance with the regulations of the Government for the time being in force relating to pensions, gratuities, leave allowances or annuities, the officer or servant would be entitled if the service had been under the Government :

Provided also that, with the sanction of the Resident, a gratuity not exceeding one-half of the cost of the annuity admissible under this section may be granted in lieu of such annuity.

Power to make rules for markets and bazaars. 4. (1) The Resident may, in respect of any market or bazaar notified under Section 2, make rules for—

- (a) the management of the market or bazaar, the levy of fees therein, and, subject to the provisions of Section 4, the collection and disposal of such fees ;
- (b) the conditions under which licenses shall be issued to brokers, weighmen, and measurers using the market or bazaar, and the fees to be charged for such licenses ;
- (c) the place or places for weighment and measuring, the description of scales, weights, and measures to be used, the periodical inspection, verification, and correction of such scales, weights, and measures, and the seizure and confiscation of such scales, weights, and measures if used in violation of such rules ; and,
- (d) generally, the guidance of such committees or persons as may from time to time be appointed for the purpose of carrying out of this Law.

(2) All rules under this Section shall be published in the *Hyderabad Residency Orders*, and shall thereupon have the force of Law.

(3) In making any rule under this section, the Resident may direct that a breach of it shall be punishable with fine which may extend to fifty rupees, and, when the breach is a continuing breach, with fine which, in addition to such fine as aforesaid, may extend to five rupees for every day after the first during which the breach continues.

5. (1) All fees under the last foregoing section shall be levied at rates calculated so as to meet, as nearly as may be, the expenditure deemed necessary for the purposes hereinafter mentioned, and the collections therefrom shall be applied in the first instance to those purposes under the direction of the Resident, and through such agency as the Resident may appoint in that behalf ; that is to say—

- (1) the maintenance and improvement of the market or bazaar in which the fees are levied, its surroundings and approaches ;
- (2) the construction and repair of buildings, *chabutras*, and other erections necessary for the purposes of such market or bazaar ;
- (3) the health, convenience, and safety of the persons using such market or bazaar ; and
- * (4) the provision of pensions, gratuities, leave allowances and annuities for any officers or servants employed in connection with a market or bazaar.

(2) The surplus (if any) shall, in the case of a market or bazaar within municipal limits, be paid over to the Municipal Committee concerned for expenditure on the purposes specified in the Berar Municipal Law, 1886, and, in the case of any other market or bazaar, to the District Board concerned for expenditure on the purposes specified in the Berar Rural Boards Law, 1885.

6. (1) No trade allowances shall be recognized in any market or bazaar notified under Section 2, and no civil court shall, in any suit arising out of a transaction entered into in any such market or bazaar, have regard to any usage or trade custom or alleged usage or trade custom to the contrary.

Abolition of trade allowances.

* This was added by Foreign Department Notification No. 3101-I.B., dated 25th July 1902.

(2) In every cotton market or bazaar notified under Section 2, all samples shall be paid for, and no civil court shall, in any suit arising out of a transaction entered into in such market or bazaar, have regard to any usage or trade custom or alleged usage or trade custom to the contrary.

(3) In every transaction entered into in any cotton market or bazaar notified under Section 2, it shall be presumed that the parties intend that cotton shall be weighed in the sacking, and that the seller guarantees that the sacking of each package shall not weigh more than ten pounds.

Explanation.—Every deduction other than deductions on account of deviation from sample when the purchase is made by sample, or of deviation from standard when the purchase is made by reference to a known standard, or on account of a difference between the actual weight, of the sacking and the standard weight, or on account of the admixture of foreign matter, shall be regarded as a trade allowance or the purposes of this Law.

7. (1) When the Resident has, by notification under Section 2, declared any place to be a market or bazaar for the sale of agricultural produce generally, or for the sale of any particular class or classes of agricultural produce, no new market or bazaar shall, except with the sanction in writing of the Resident and subject to such conditions as the Resident may think fit to impose, be established for the like purpose within five miles of the market or bazaar notified as aforesaid.

(2) Whoever establishes a market or bazaar in contravention of this section or violates the conditions under which he is authorised to establish a market or bazaar under this section, shall be punishable, with fine which may extend to fifty rupees, and, in the case of a continuing breach, with fine which, in addition to such fine as aforesaid, may extend to five rupees for each day after the first during which the breach continues.

Recovery of fees.

8. Fees leviable in pursuance of any rules under this Law may be realized as fines under the orders of any Magistrate.

9. The bazaar cess, the levy of which was authorised by the Notification of the Government of India in the Department of Revenue, Agriculture, and Commerce, No. 11, dated the 27th January 1875, shall cease to be levied in any market or bazaar notified under Section 2.

Abolition of existing bazaar cess in markets or bazaars notified under Section 2.

W. J. CUNINGHAM,

Secretary to the Government of India.

(ii) Rules under the Berar Cotton and Grain Markets Law.

HYDERABAD RESIDENCY ORDERS.

Notification No. 79-B., dated Hyderabad Residency, the 1st April 1918.

(As amended up to the 31st July 1914.)

The Resident in exercise of the powers conferred on him by section 4* of the Berar Cotton and Grain Markets Law, 1897, is pleased to make the following Rules for the purposes specified therein. These Rules shall come into force from the date of this notification :—

Appointment of the Managing Committee.

1. Immediately on the publication of these orders, and hereafter on or as soon as possible after the 1st April in each year, the Deputy Commissioner shall prepare a list of persons eligible for appointment as members of the Managing Committee of a market or bazaar.

Preparation of lists of persons eligible for appointment.

* Residency Orders Notification No. 258, dated the 7th October 1902.

[Qualification of members.]

2. The following persons shall be eligible for appointment :—

- (1) Every member of the Municipal Committee—if the market or bazaar is situate within municipal limits—who is not in any way personally interested in the cotton trade.
- (2) Every person who on his own account, or on account of the undivided Hindu family of which he is the manager, has in the financial year immediately preceding the financial year in which the appointment is made, purchased or sold in the market, as evidenced by the market registers, not less than 100 *bhojas* of ginned cotton or 100 *khandis* of unginned cotton.

NOTE.—For the purpose of these rules ginned cotton includes cotton from which the seed has been removed by any process whatever.

- (3) The principal agent, or, if the principal agent is otherwise disqualified, the next senior agent or servant, of every firm or company which has in the financial year next preceding the financial year in which the appointment is made, purchased or sold in the market, as evidenced by the market registers, not less than 500 *bhojas* of ginned cotton (200 *bhojas* for Karinja cotton market) or not less than 500 *khandis* of unginned cotton (200 *khandis* for Karinja cotton market) :

Provided that no person shall be eligible for the appointment who—

- (a) has not resided within the limits, or within five miles from the limits, of the town or municipality, as the case may be, in which the market or bazaar is situate for three months on the date on which the list is prepared ;
- (b) is a female, is not 21 years of age, is of unsound mind, or is affected with incurable disease ;
- (c) has been declared an insolvent, or has been convicted of such offence, or has been subjected by a Criminal Court to such order as implies, in the opinion of the Deputy Commissioner, a defect in character which unfits him to serve as a member of the Committee ;
- (d) is a clerk or servant of the Committee, or is a licensed broker, or is a licensed weighman ; or
- (e) has directly or indirectly any share or interest in any contract or employment with, or on behalf of, or under, the Committee ;
- (f) being a buyer or seller has not registered his name under rule 50.

- * (4) An *aratya* who has in the financial year last preceding the financial year in which the appointment is made, purchased or sold in the market, as evidenced by the market registers, not less than 500 *bhojas* of ginned cotton or not less than 500 *khandis* of unginned cotton.

Explanation.—An *aratya* means and includes a general commission agent who in consideration of *arat* or commission offers to make or makes purchases or sales of *kapas* or cotton and offers to do or does all things necessary for completing and carrying out those purchases, or sales for and on account of others, that is, his principals or constituents.

3. A copy of the list prepared by the Deputy Commissioner shall be exhibited on a board for public information at each of the following places, namely :—

- The Deputy Commissioner's office ;
- The Tahsildar's office ;
- The office of the Municipal Committee ; and
- The principal gate of the Cotton Market.

4. The Deputy Commissioner may, if he thinks fit, at any time, on receipt of

Correction of lists prepared by the Deputy Commissioner.

an application, enter in the list the name of any person who is eligible for appointment, and may from time to time order the removal from the list of the name of any person who has ceased to be eligible for appointment.

5. A person shall become ineligible for appointment if he ceases to be a member of the Municipal Committee, or if he ceases to reside within the limits of the town or municipality, as the case may be, in which the market or bazaar is situate, or within five miles from such limits. A person shall be held to have "ceased to reside" if he is continuously absent from his residence for four months, and for eight months in case of Karinja Municipality.

6. On or as soon as possible after the 15th June in every year the Deputy Commissioner shall submit for the Commissioner's approval not less than five persons selected from the list prepared under rule 1 for appointment to the Committee of Management. Such Committee shall ordinarily consist of five members, but shall not be considered to be improperly constituted by reason only of the number of members being at any time less than that number.

Selection shall ordinarily be made by the Deputy Commissioner in the following manner :—

- (a) Two of the five members of the Committee shall be elected by the Municipal Committee at a special meeting to be held not later than the 31st May in each year from among such of the members of the Municipal Committee as may be fully qualified under rule 2, and the result shall be communicated to the Deputy Commissioner before the 8th June following.
- (b) The remaining three members of the Committee shall be elected by ballot at an election to be held by the Deputy Commissioner or such officer as he may depute for the purpose not later than the 10th June by the persons appearing on the list prepared by the Deputy Commissioner under the foregoing rules.
- (c) In the event of the Municipal Committee failing to elect and report the election of two representatives by the date prescribed above, or electing and reporting the election of only one by that date, or in the event of the market not being situated within municipal limits the vacancies, one or two, as the case may be, shall be filled by election as provided in clause (b) of this rule or by nomination by the Deputy Commissioner, as that officer may decide.
- (d) The ballot shall be scrutinized by the Deputy Commissioner or by an officer appointed by him for the purpose, and their decision thereon shall be recorded in writing and deemed final. In the event of the votes being equal in any case, the officer conducting the election shall have a casting vote.
- (e) Should the persons entitled to vote under clause (b) fail to elect the number of members required, the Deputy Commissioner shall nominate them, and should the Commissioner not approve of the names submitted after election or otherwise, the nomination and appointment of other persons in their place shall rest with the Deputy Commissioner and the Commissioner.
- (f) No second election will be held under any circumstances.

7. The names of the persons approved by the Commissioner shall be notified in the *Central Provinces Gazette*, and they shall come into office on the first day of the November * next following their appointment. A member appointed to fill a casual vacancy shall come into office on the date on which his appointment shall have been notified in the *Central Provinces Gazette*. All members shall vacate office on the first day of November * following the date of their entrance into office : provided that between the date on which these rules come into force and the thirty-first day of October 1898 a provisional committee shall be nominated by the Deputy Commissioner and appointed by the Commissioner in the manner provided by the

* Residency Orders Notification No. 340, dated the 16th December 1902.

first paragraph of rule 6, such provisional committee being composed as far as may be of the members of the committee already in office when these rules are published.

8. A casual vacancy occurs when a member having died resigned, or become ineligible for office, whether before entry into office or during the term of office, the Deputy Commissioner, on the matter being brought to his notice, declares a vacancy. It shall be the duty of the Chairman of the Committee to bring to the notice of the Deputy Commissioner facts which would justify the Deputy Commissioner in making such a declaration. On the occurrence of a casual vacancy, the Deputy Commissioner shall submit the names of not less than two persons for the Commissioner's approval, and the person selected by the Commissioner shall thereupon succeed to the vacancy.

9. Nothing in these rules shall be deemed to prevent the Chief Commissioner from at any time superseding a Committee or removing any member from the Committee and appointing other members either in lieu of or in addition to the members appointed under these rules, and from selecting such members in such manner as he may consider advisable.

Powers of Chief Commissioner as to appointment and removal of members.

The powers and duties of the Committee.

10. The Committee shall so far as the funds at its disposal will permit, but subject to the provisions of these rules, and to such exceptions and conditions as the Deputy Commissioner may, subject to the provisions of these rules, from time to time make and impose, provide (1) for the maintenance and improvement of the market, its surroundings, and approaches: (2) for the construction and repair of buildings, *chabutars*, and other erections necessary for the purposes of the market; and (3) for the health, convenience, and safety of the persons using the market.

11. The Committee may, with the previous sanction of the Deputy Commissioner, from time to time make rules consistent with these rules as to—

- Power of Committee to make rules.**
- (a) the time and place for meetings;
 - (b) the manner of convening meetings and of giving notice therefor;
 - (c) the quorum required at meetings;
 - (d) the conduct of proceedings at meetings;
 - (e) the division of duties among the members;
 - (f) the persons by whom receipts may be granted on behalf of the Committee for money paid; and
 - (g) the guidance of all persons employed or appointed for the purpose of carrying out the law or the rules framed under the law.

12. The Committee may also appoint one or more of its members to be a sub-committee or to be a joint-committee for the conduct of any work or works, or to report on any matter or matters, and may delegate to any one or more of its members such of its own powers as may be necessary.

Appointment of sub-committee or joint-committee, and delegation of duties to members.

The Chairman: his powers and duties.

13. The Committee shall, subject to the confirmation of the Deputy Commissioner, appoint one of its members to be Chairman. He shall conduct all correspondence. All contracts shall be entered into in his name, and the servants of the Committee shall, subject to these rules and to the orders of the Committee, be subject to his control. He shall keep the accounts, shall be responsible for the punctual rendition of all reports and returns, and for the custody of all monies not deposited in the treasury or with a banker, and shall be the chief executive officer of the Committee.

The Chairman.

14. The Chairman shall, subject to the provisions of rule 15, hold office from the date of his appointment until a new Committee has come into office. But in the event of the Chairman's dying, resigning, or become incapable of acting, the Committee shall appoint another Chairman.

Term of office of, and casual vacancies in office of, Chairman.

15. A Chairman may be removed by the Chief Commissioner by reason of his having ceased to be eligible for appointment as member of the Committee or for any other cause.
Removal of Chairman by the Chief Commissioner.

Meetings of the Committee.

16. The Chairman, or, in his absence, a member selected for the occasion, shall preside at meetings, and the Chairman or presiding member shall be entitled to speak and vote on all questions, and shall also have a casting vote in every case in which the votes are equally divided.
Chairman to preside.

17. A minute book shall be kept for permanent record, and a record of the proceedings, at every meeting, shall be made by, or under the supervision of, the Chairman or other presiding member, and shall be signed by him.
Minute book to be kept.

18. The Deputy Commissioner, or the Chairman of the Municipal Committee, or any member authorized in writing by such Deputy Commissioner or Chairman, shall be entitled to attend any meeting of the Committee and to address the Committee on any matter.
Officers entitled to attend meetings.

19. The meetings of the Committee shall, as a rule, be open to the public, but on a motion carried by two-thirds of the members present, strangers may be required to withdraw.
Meetings open to the public as a rule.

20. A copy of the proceedings of every meeting of the Committee shall be forwarded to the Deputy Commissioner forthwith, and, if the market or bazaar is situate within municipal limits, through the office of the Municipality.
Copy of proceedings of meetings.

21. References from the Committee to any Government officer shall be made through the Deputy Commissioner.
References.

Servants of the Committee.

22. The Committee may employ such servants as may be necessary and proper for the efficient execution of its duties, and may assign to such servants such pay as it thinks fit.
Employment of servants.

23. When any appointment is made by the Committee to an office carrying a salary exceeding Rs. 10 per mensem, the Committee shall furnish to the Deputy Commissioner full particulars in writing regarding the age, parentage, caste, residence, and qualifications of the person appointed and the salary allotted to him.
Appointments of servants.

NOTE.—Original Rules 26 and 27 were cancelled and Rules 28 to 83 were renumbered as Rules 26 to 81 by Residency Orders Notification No. 258, dated the 7th October 1902.

24. No servant of the Committee in pensionable employ drawing a salary exceeding Rs. 10, nor any other servant drawing a salary of Rs. 25 or upwards, and no Government official employed by the Committee, shall be dismissed or degraded save with the previous sanction of the Deputy Commissioner.
Dismissal of servants.

25. If in the opinion of the Deputy Commissioner—

(a) the number of servants employed by the Committee under rule 22 or the pay assigned by the Committee to these servants or to any particular servant is excessive; or
Control of the Deputy Commissioner over establishments.

(b) any such servant is unfit for his employment, the Committee shall, on the requisition of the Deputy Commissioner, reduce the number or the pay, or, as the case may be, dismiss the unfit servant.

Restrictions on the powers of the Committee.

26. The Committee shall be guided by those general principles of which the Government has approved in their several departments of administration.
Committee to be guided by Government rules.

27. The Committee shall take all possible steps to secure an adequate check on the due crediting of receipts and on payments made by its officers and servants, and it shall furnish to the Deputy Commissioner all information he may require regarding the action taken in this respect.

28. The Committee shall make due arrangements to insure that works sanctioned have been duly executed.

29. All receipts on account of fees recovered under these rules and all other items of income whatsoever shall be daily credited in full into the Government treasury or subtreasury where there is one, and all balances shall be kept in such treasury, and shall not be drawn out except in accordance with these rules.

*29-A. The surplus of the Cotton Markets on the 31st October shall be transferred on the 1st November of each year to the Municipal Committee or the District Board concerned under Section 4 (2) of the Berar Cotton and Grain Markets Law, 1897.

NOTE.—The word “surplus” shall be taken to mean all unexpended balances.

30. All payments shall be made on cheques drawn on behalf of the Committee.

31. Every cheque drawn on behalf of the Committee shall be signed by the Chairman, or, in his absence, by two other members. No such cheque may be drawn except on a bill which has been examined and passed by the Chairman or on the issue or recoupment of an imprest, if any. And the said Chairman shall not pass any bill for payment without the previous sanction of the Committee, except to provide for the following matters :—

(1) Salary of fixed establishment.

(2) Payment for works and repairs sanctioned by competent authority.

(3) Sums for emergent purposes which, in anticipation of the sanction of the Deputy Commissioner, may be met on the authority of the Chairman :

† Provided that, in the absence of the Chairman from the town, bills for payments of the above nature may be passed and signed by any two members.

32. No payment shall be made from the Government treasury on any cheque purporting to be drawn on behalf of the Committee unless it be signed by the Chairman or by two members

Authority to sign cheques.
as already provided.

‡32-A. All remittances to the treasury shall be accompanied by challans in duplicate and a pass-book. Upon receipt of the money by the treasury, both sides of the pass-book shall be written up to date by the Treasury Accountant : the entries shall be initialled by the Treasury Officer and the books returned.

32-B. The pass-book is not an account book of the Committee, but is simply a copy of the account kept in the Treasury of the money paid in and withdrawn on behalf of the Committee and must therefore always be written up by the Treasury Department by whom the original account is kept.

32-C. At the close of each month, the balance in the pass book shall be struck and the amount written in words and signed by the Treasury Officer.

33. Provision for works and repairs may be made in the budget-estimate under the following sanctions :—

(1) When the cost of the work is less than Rs. 200, the sanction of the Committee ;

(2) When the cost of the work exceeds Rs. 200, the sanction of the Deputy Commissioner and subject to the preparation of plans in the case of all works the cost of which is likely to exceed Rs. 50.

* Residency Orders Notification No. 340, dated the 16th December 1902.

† Central Provinces Gazette Notification No. 241, dated the 3rd March 1914.

‡ Central Provinces Gazette Notification No. 11591, dated the 3rd October 1904.

34. Plans and estimates for works estimated to cost less than Rs. 200 shall

Evidence of sanction.

be signed by the Chairman, and plans and estimates for works estimated to cost more than Rs. 200 shall be signed by the Chairman and by the Deputy Commissioner, in token of approval of design and cost. In the case of original works estimated to cost more than Rs. 500, the professional approval of the Executive Engineer of the district shall be obtained and evidenced by his counter-signature.

35. All works shall be carried out under the supervision of the Chairman unless the Deputy Commissioner in any particular case directs otherwise.

Supervision of works.

36. Contracts entered into by the Committee shall ordinarily be reduced to writing and the provisions of the Stamp and Registration Acts shall be complied with. Written contracts shall be signed on behalf of the Committee by the Chairman and one member.

Contracts.

Annual budget and accounts.

*37. For the purposes of the rules following the cotton market year shall be held to commence on the 1st November and end on the 31st October.

The Committee shall annually hold a special meeting in the first week of June and shall prepare a budget of income and expenditure for the ensuing year. The budget shall be submitted to the Deputy Commissioner, who shall sanction the same with such alterations as he may consider proper and shall communicate the sanctioned budget to the Committee. The Committee shall regulate their expenditure in accordance with it.

Annual accounts and audits.

38.† Annual account: for the past year shall be submitted to the Deputy Commissioner annually along with the budget.

38-A.‡ The accounts of the cotton markets shall be audited locally by the Local Audit Establishment of the Comptroller, Central Provinces. At the time of audit the Chairman, Vice-Chairman or Secretary shall cause to be produced all accounts, registers, documents and subsidiary papers which may be called for by the audit officer for the purposes of his audit. Any explanation called for by that officer for the settlement of any discrepancy shall also be immediately furnished to him.

To meet the cost of the Local Audit Establishment, the Cotton Market Funds will, with effect from the 1st April 1904, contribute to the Provincial Revenues one per centum on the total annual expenditure. In calculating the total expenditure on which fees are to be levied, all amounts falling under the heads of "Advances and Deposits," including the amount of expenditure on Public Works audited by the Examiner, Public Works Accounts, and the surplus amount paid, are to be left out of account.

The collection of fees.

Fees to be levied

39. The following fees shall be levied in the market :—

(1) On every package (*docra* or *akha*) of ginned cotton, six pies.

(2) On every cart laden with unginned cotton, one anna.

40. The fee shall be payable as soon as the cotton is brought into the market ;

Recovery of fees.

but, unless there is reason to fear that the duty will be evaded, it shall not be recovered till the cotton is after sale removed from the market yard.

Receipts to be granted and register of collections to be kept.

41. A receipt shall be granted to the payer in respect of every fee collected under these rules, and a register of collection shall be kept.

Fees to be collected by paid servants.

42. The fees shall be collected by paid servants of the Committee, and shall not be farmed out.

* Revised by *Central Provinces Gazette* Notification No. 689, dated the 25th October 1906.

† Revised by *Central Provinces Gazette* Notification No. 8784, dated the 31st July 1905, and No. 689, dated the 25th October 1906.

‡ *Central Provinces Gazette* Notification No. 8784, dated the 31st July 1905.

Servants employed on the collection of fees to wear badges.

43. Every servant employed by the Committee for the collection of fees shall wear a suitable badge of office provided by the Committee.

Penalty for evasion of payment of the fees. 44. Any person removing or attempting to remove cotton from the market yard before the fee has been paid and the receipt prepared and granted, or practising any device in order to evade or facilitate the evasion of the payment of the fee, shall be liable to a fine not exceeding Rs. 50.

Custody of collection. 45. Every person authorized to collect the fees shall be provided with a locked money box, the key of which shall remain in the charge of the Chairman. The receipts shall be placed in the box by the payee, or in his presence by the person receiving the same and the box shall be opened daily at a fixed hour by the Chairman or such other member of the Committee as may be appointed for the purpose, who will be responsible for comparing the counterfoil receipts and register of receipts with the amount actually received.

Management of the market.

Area of the market. 46. For the purposes of these rules, the area of every market entrusted to the management of the Committee shall include—

- (1) the market yard (the enclosure bounded by walls and railings known as the cotton market yard);
- (2) the market proper (including all land, the property of the Government or of the Municipality, within a radius of 500 yards from the centre of the market yard); and
- (3) the approaches (including all lands, the property of the Government or of the Municipality, within a radius of one mile from the centre of the market yard).

Control and conservancy of the market yard. 47. The Committee shall have the absolute control of the market yard, and, subject to these rules and to the orders of the Chief Commissioner and to such control as is by these rules or by any other law vested in the Deputy Commissioner or in the Municipal Committee, shall manage it as if it were the private property of the Committee, having regard always to the convenience of the cotton trade and the purpose for which the control is transferred to the Committee. The gates shall be opened and closed at such hours as the Committee may from time to time direct; the carts shall stand in such place and for such times as may be permitted, and ingress and egress may be permitted, to such persons and at such times, as the Committee may consider proper. The conservancy of the market yard shall be a first charge on the funds at the disposal of the Committee, and the upkeep of roads, wells, water-troughs, and buildings shall be wholly charged to that fund, and the Committee shall be responsible for the perfect conservancy of the yard and for the upkeep of the roads, well, water-troughs, and buildings therein:

Provided that no registered buyer or registered seller or registered buyer and seller shall be excluded from the yard at any time when the yard is open to the general public.

Powers of the Committee. 48. In the market proper, the Committee shall exercise such rights only as may be necessary for the more convenient enjoyment of the control of the market yard and for the convenience and comfort of the persons using the market and for the collection of the fees. The Committee and, if the market or bazaar is situate within municipal limits, the Municipal Committee shall be jointly responsible for the conservancy of this area and for the proper repair and upkeep of all public roads in this area; but the cost of such conservancy and the expenditure required for the upkeep of roads in this area shall be borne wholly by the Committee, unless the Deputy Commissioner, for reason to be recorded by him, after consulting the Committee and Municipal Committee, decides otherwise. Subject to police and municipal orders and rules, in this area, exercise such control over carts,

cartmen and passenger as may be necessary to prevent traffic to and from the market being impeded. They may also prevent any cart laden with cotton, and specially if duty has not been paid, from standing in any portion of the area or entering the area without express permission. In the approaches the Committee will exercise no control (except that they may regulate places at which carts laden with cotton may stand, and the roads by which and the times within which they may move); but they shall, if the market or bazaar is situate within municipal limits, out of the funds at their disposal, and to the extent of funds at their disposal, make such contributions to the funds of the Municipality as may in the opinion of the Deputy Commissioner, after consultation with the Committee and with the Municipal Committee, from time to time appear reasonable, having regard to the filth deposited by, and the wear and tear to roads caused by, carts laden with cotton, and the bullocks and attendants appertaining to them.

49. Any person entering or attempting to enter the market yard when directed not to do so, or disobeying the directions of the Committee in regard to the places where carts laden with cotton may stand, or in regard to the roads by which, and in regard to the times at which, they may proceed, shall be liable on conviction to a penalty not exceeding Rs. 10 for the first offence and Rs. 50 for any subsequent offence.

50. Any person shall, on application at the office of the Committee, be entitled to have his name immediately registered as a buyer or as a seller or as a buyer and seller on his executing an agreement in such form as the Commissioner may from time to time prescribe, agreeing to conform to the market rules, and on his paying such fee, if any, not exceeding Rs. 50 per annum, as the Committee with the previous sanction of the Commissioner, may from time to time prescribe :

*Provided that in the case of *aratyas* or agents acting for or employed by more than one person or by more than one firm, every such *aratya* or agent shall make an application at the office of the Committee to have his name registered and on his executing an agreement in such form as the Commissioner from time to time prescribes, agreeing to conform to the market rules, and upon his paying such fee, if any, not exceeding Rs. 100 per annum, as the Committee, with the previous sanction of the Commissioner, may from time to time prescribe, his name shall immediately be registered as a buyer or seller or as a buyer and seller according as he may have requested in the application, and any such *aratya* or agent who does not conform or refuses to conform to the conditions of this proviso shall not be entitled to buy or sell in the market on account of his principles or constituents.

51. The Committee may remove from the register the name of any person registered as a buyer or as a seller or as a buyer and seller who violates the conditions of his agreement, either permanently or for a fixed period not exceeding three months. In the event of there being a dispute as to whether the conditions of the agreement have been violated or not, the matter shall, after all the evidence on both sides has been recorded by the Chairman, be referred to the Deputy Commissioner for decision. The Deputy Commissioner shall decide the question on a perusal of the papers either after hearing or without hearing the parties, and his decision on that point shall be final. On the application of the Chairman, the Deputy Commissioner may depute any other officer subordinate to him to record the evidence. In the event of the Committee removing the name of any person permanently, the confirmation of the Deputy Commissioner shall be necessary.

52. No registered buyer or registered seller or registered buyer and seller shall weigh for delivery any cotton purchased or sold by him with any scales except authorized scales, or with any weights or chains except authorized weights and chains, and every registered buyer and every registered seller and every registered buyer and seller evading or attempting to evade this rule shall be held to have violated the conditions of his agreement.

* Central Provinces Gazette Notification No. 490, dated the 19th April 1909.

The licensing of brokers and weighmen.

53. The Committee shall license such and so many persons as may from time to time appear proper to be licensed brokers and to be licensed weighmen, and the Committee may at any time withdraw any license granted by it :

Licensed broker and licensed weighman.

Provided that no license shall be refused or withdrawn except on grounds which are reasonable and proper, and that the persons who hold licenses at the date when these rules come into force or have already obtained a license (as the case may be) shall have a preferential claim. In case a question arises as to whether the grounds on which a license has been refused or withdrawn are reasonable and proper, an appeal on the question shall lie to the Deputy Commissioner, and his decision thereon shall be final :

Provided also that no private servant shall be licensed as a broker or as a weighman, and that a licensed broker or weighman taking service shall *ipso facto* cease to be licensed.

54. Licenses shall remain in force for one year only, but may be renewed, and shall be issued and renewed on the payment of such fees as the Committee, with the previous sanction of the Commissioner, may from time to time prescribe.

Duration of license.

Scale of fees.

55. Unless and until another scale of fees is prescribed, the following fees shall be charged :—

For each broker, Rs. 20 per annum.

For each weighman, *Nil*.

56. No person shall, in the absence of express agreement, be bound to employ a broker or weighman in any transaction, or be required to pay for a broker or weighman employed by any other party to the transaction, or to pay for a broker or weighman when none is employed.

Employment of broker or weighman not compulsory.

57. The following fees may be demanded by a licensed broker on account of his services when employed from the person employing him :—

Fees payable to licensed broker.

(a) In respect of services rendered to a purchaser, a fee not exceeding four annas three pies per *bhoja* of ginned cotton or *khandi* of unginned cotton ;

(b) In respect of services rendered to a seller, a fee not exceeding four annas three pies per *bhoja* of ginned cotton or *khandi* of unginned cotton :

Provided that in case the same broker is employed by both parties, the licensed broker shall not demand more than four annas three pies per *bhoja* of ginned cotton or *khandi* of unginned cotton, as the case may be.

58. The following fees may be demanded by a licensed weighman on account of his services when employed from the person employing him :—

Fees payable to licensed weighman.

(a) In respect of services rendered to a purchaser, one anna six pies per *bhoja* of ginned cotton or *khandi* of unginned cotton ;

b) In respect of services rendered to a seller, one anna six pies per *bhoja* of ginned cotton or *khandi* of unginned cotton :

Provided that in case the same licensed weighman is employed by both parties, the licensed weighman shall not demand more than two annas three pies per *bhoja* of ginned cotton or *khandi* of unginned cotton as the case may be.

Fees to be paid in moieties by buyer and seller when both parties employ the same licensed broker or weighman.

59. If both parties employ the licensed broker or weighman, the fees of the broker or weighman shall, in the absence of express agreement, be payable half by the buyer or half by the seller.

Licensed broker and weighman to wear a distinguishing badge.

60. Every licensed weighman when plying his trade shall wear a distinguishing badge of a suitable pattern to be provided by the Committee.

61. Any person practising in the market as a broker or weighman without a license or any weighman plying his trade without a badge shall be liable on conviction to a fine not exceeding Rs. 50.

Penalties for plying trade without license or badge.

62. Servants and agents employed to purchase or sell or to bargain for cotton on account of others, whether remunerated by fees or not, are not brokers within the meaning of the term as used in these rules, provided that they are employed by one person or by one firm only, and that they do not obtain or demand fees from any other person except the one person or firm that employs them

Servants and agents employed to purchase or sell not brokers within the rules.

63. Servants and agents employed to weigh cotton by a single firm or individual, howsoever remunerated, are not weighman within the meaning of the term as used in these rules so long as they weigh for and under the orders of that firm or individual alone and do not receive or demand fees from any person other than the firm or individual by whom they are solely employed.

Servants and agents employed by a single firm or individual to weigh cotton not weighmen within the rules.

64. No license shall be granted to any person who is employed to purchase or to sell for, or to bargain for, or to weigh for, any firm or individual, and any licensee taking or agreeing to take such employment shall cease to be a licensed broker or weighman, as the case may be.

License not to be granted to any person employed either as broker or weighman by a single firm or individual.

65. Any licensed broker or any licensed weighman who shall demand, receive, or retain, or shall allow any other person to demand, receive, or retain, on account of, or under the colour of, fees due in respect of his service, any sum not demandable under these rules, or a larger sum than is demandable under these rules, or from a person who is not liable to pay under these rules, and any person who, not being a licensed broker or weighman, shall demand, receive, or retain, or facilitate the demanding, receiving, or retaining of such sums, shall be liable on conviction to a fine not exceeding Rs. 50.

Penalties to licensed broker or weighman for demanding or receiving any sum not authorized by these rules.

66. Every broker and every weighman licensed under these rules shall keep such books in such form and render such daily and monthly returns at such time and in such form as the Deputy Commissioner or the Committee shall, from time to time prescribe, and shall render such assistance in the collection of duties and in the prevention of the evasion of duty and breach of the rules as may be required by the Committee.

Books to be kept by licensed brokers and weighmen.

The regulation of weights and their inspection and confiscation.

67. The following descriptions of weights shall alone be used for the weightment of cotton in bulk in the market :—

Description of weights to be used.

- (a) 7 maund weight of 196 lbs. (Avoirdupois).
- (b) 4 maund weight of 112 lbs. (Avoirdupois).
- (c) 2 maund weight of 56 lbs. (Avoirdupois).
- (d) 1 maund weight of 28 lbs. (Avoirdupois).
- (e) 2 dhara weight of 14 lbs. (Avoirdupois).
- (f) 1 dhara weight of 7 lbs. (Avoirdupois).
- (g) 4 lbs. weight of 4 lbs. (Avoirdupois).
- (h) 2 lb. weight of 2 lbs. (Avoirdupois).
- (i) 1 lb. weight of 1 lb. (Avoirdupois).
- (j) Chain weighing 10 lbs. (Avoirdupois).

*67-A. A weight equivalent to the weight of the rope which is used to suspend a bundle of cotton (*docra*) on the weighing side of the scales shall be added to the

* Residency Orders Notification No. 47, dated the 13th February 1900.

weight side of the scales, in order to counterbalance the weight of the rope attached to the weighing side of the beam.

68. Weights of the above description and weight are authorized. All weights intended to be used for, or capable of being used for, the weighment of cotton in bulk which do not answer

Unauthorized weights. one of the above descriptions are unauthorized.

69. The Chairman, every member of the Committee, and every employee of the Committee authorized by the Committee in this behalf, shall be entitled, at any time and without notice, to inspect, examine, and test any scale or weight used, kept, or possessed in any open place within the limits of the market.

70. Every registered buyer, every registered seller, every registered buyer and seller, and every trader in cotton residing or trading within the limits of the market, shall, on a requisition in writing being made to him by the Chairman or by any two members of the Committee, immediately produce for examination all and every scale and weight used, kept, or possessed by him, or by any person or persons under his authority or control, and shall allow the said Chairman or the said two members to inspect, examine, and test the same.

71. Every scale found on examination to be untrue and every weight found on examination to be unauthorized or incorrect shall be forthwith forwarded with a report, in such form as the Deputy Commissioner may from time to time prescribe, to such Magistrate as the Deputy Commissioner may from time to time appoint, and the Magistrate shall order the confiscation and destruction of such scales or weights, or make such other order in the matter, as may appear proper.

72. Whoever being bound under the provisions of rule 70 to produce any scale or weight for examination, or to allow the examination, inspection, or testing of any scale or weight, does not immediately produce the scale or weight, or does not allow the examination, inspection, or testing of the scale or weight, shall be liable on conviction to a fine not exceeding Rs. 50.

73. Whoever being a licensed broker or a licensed weighman, or a registered buyer or a registered seller, or a registered buyer and seller, or a trader in cotton, shall have in his possession, keep, or use any scale or weight which is false, incorrect, or unauthorized, shall be liable on conviction to a fine not exceeding Rs. 50.

74. A conviction under rules 72 and 73 shall not bar a prosecution under the Indian Penal Code or under any other law by which the offender may be liable to punishment in respect of the same.

General.

75. The Committee may, subject always to the sanction of the Deputy Commissioner, make subsidiary rules not inconsistent with these rules as may appear advisable. In the event of their suggesting any alteration in these rules, the suggestion shall be forwarded to the Deputy Commissioner, and, if the market or bazaar is situate within the municipal limits, through the office of the Municipal Committee, and the Municipal Committee shall be entitled to make such observations in regard to the proposals as may to them appear proper.

76. No licensed broker, licensed weighman, registered buyer, registered seller, or registered buyer and seller, and no trader in cotton, shall be allowed to demand, take, or retain a trade allowance or unpaid-for sample in regard to any cotton transaction entered into in the market, and any person demanding, taking, or retaining such allowance or unpaid-for sample, or assisting or abetting any other person in demanding, taking,

or retaining such trade allowance or unpaid-for sample, or in any way facilitating or conniving at the demanding, taking, or retaining of such trade allowance or unpaid-for sample, shall be liable on conviction to a fine not exceeding Rs. 50 for each offence.

77. A sample which it is intended to pay for on weighment is not an unpaid-for sample. • The question whether it is intended to pay for it on weighment or not is a question of fact to be decided by the Magistrate.

Samples.

78. A maund means 28 lbs. of unginned or ginned cotton or cotton seed. A *bhoja* means 392 lbs. (avoirdupois) of ginned cotton, and a *khandi* means 784 lbs. (avoirdupois) of unginned cotton or cotton seed.

Definition of maund, bhoja and khandi.

79. The Committee shall keep a set of authorized weights, which shall be at all times available to the public for comparison with their own weights at all reasonable hours.

A set of authorized weights to be kept by the Committee.

80. No prosecution shall be instituted for any breach of any of these rules without the previous sanction of the Committee or of the Chairman or other officer authorised by the Committee in this behalf. No prosecution shall be instituted against a registered seller, or against a registered buyer or registered buyer and seller, until he has been given an opportunity of explaining his conduct, and then only under the special orders of the Committee passed at a special meeting, of which notice shall be given to all the members.

Prosecution not to be instituted without previous sanction.

81. Notwithstanding anything contained in rule 77, a prosecution for any offence under these rules may at any time be instituted by the Deputy Commissioner.

Powers of Deputy Commissioner to institute prosecutions.

(By Order),

C. H. A. HILL,

Secretary for Berar.

APPENDIX VII.

List of recommendations and conclusions.

Chapter II.—The Punjab.

No.		PARA.
	In regard to botanical work :—	
1	Further experiments should be made with the varieties of American cotton 280F and 285F.	19
2	Efforts should be made to improve the varieties of <i>deshi</i> cotton, <i>G. indicum</i> or <i>G. neglectum malvanse</i> , and to evolve a strain of uniform staple giving a better profit per acre than any of the constituents of the mixture at present grown.	20
	In regard to agricultural work :—	
3	The rotation, cotton after <i>toria</i> , is the most suitable and its adoption should be generally recommended.	21
4	The practice of sowing in lines and of interculturing is calculated to bring about a considerable increase in the outturn of cotton and the Agricultural Department should endeavour to promote its adoption.	21
5	No special seed farms for American cotton are necessary, but such farms will be required if superior varieties of <i>deshi</i> cotton are evolved or if there is any extension of American cotton in other parts of the Province. Steps should be taken to select suitable sites for such farms at an early date.	22
6	Cotton markets should be established in the Lower Chenab Lower Jhelum and Lower Bari Doab Canal Colonies.	23
7	The work connected with auction sales of cotton and seed distribution should be devolved on organizations of <i>zamin-dars</i> , whether in the form of co-operative societies or otherwise, as soon as possible.	23
	In regard to cotton under irrigation :—	
8	The possibility of growing American cotton under well irrigation in the Eastern Punjab and also under the inundation canals in the south-west of the Province should be thoroughly tested. Experiments should also be made with American cotton in the eastern and northern parts of the area commanded by the Sirhind Canal.	19 and 26
9	The possibility of completing the Shahpur Branch of the Lower Jhelum Canal by leaving the private inundation canals in the Jhelum District out of the scheme should be investigated.	31
10	The question of the supplies to the Haveli Project and the possibility of supplementing them by the Sind Sagar Doab Project should be investigated.	34
11	An area of 465,000 acres of American cotton under existing canals and of 200,000 acres under projected canals may be anticipated.	37
12	In view of the effect of the projects under consideration in the Punjab on the supplies in the Indus, it is essential that the construction of the Sukkur Barrage Project in Sind should be taken in hand at an early date.	38

No.		PAGE.
13	A thorough investigation of the supplies available in the Indus and other Punjab rivers should be carried out.	38
14	In order that the effect of increased <i>kharif</i> supplies on the cultivation of cotton may be tested, a large distributary should be selected on one of the perennial canals to which greatly increased <i>kharif</i> supplies should be given. An agricultural officer should be placed on special duty to advise the cultivators under the distributary in regard to croppings and rotations.	38
15	A thorough investigation of the possibilities of tube wells and of pump irrigation should be taken in hand at an early date.	40
	In regard to agricultural staff :—	
16	The Punjab should be divided into six circles, for which three additional Deputy Directors of Agriculture and at least three additional Assistant Directors will be required.	41
17	An additional botanist with special qualifications for research should be appointed, his main work to be on <i>deshi</i> cotton.	41
18	The officer appointed to fill the post of entomologist already sanctioned should be an agricultural and not a systematic entomologist.	41

Chapter III.—The North-West Frontier Province.

As regards cotton under irrigation :—

19	The possibilities both of <i>deshi</i> and American cotton should be thoroughly tested on the Upper Swat Canal.	47
20	If the scheme for making the Paharpur Inundation canal perennial is carried out, an area of 12,000 acres under American cotton may be expected on that canal.	49
	In regard to staff and lines of work :—	
21	A Deputy Director with botanical training should be appointed to the Province whose first duty should be to carry out a survey of the cotton tracts and to investigate the possibilities of American cotton on the Upper Swat canal and in the Dera Ismail Khan district.	51
22	Selection work on Peshawar cotton should be undertaken with a view to obtaining an improvement in the ginning percentage.	51
23	The Agricultural Department in the North-West Frontier Province should work in close touch with the Punjab Agricultural Department in all matters connected with cotton.	51

Chapter IV.—The United Provinces.

In regard to botanical work :—

24	One of the varieties of Cawnpore American at present being tested by Mr. Burt should be given out as soon as possible in order to render the crop more uniform in staple and quality than is the case at present.	58
25	The experiments with <i>buri</i> should be abandoned and the energies of the Agricultural Department should be concentrated on the Cawnpore American variety.	58
26	Mr. Leake's work at Cawnpore on the improvement of <i>deshi</i> cotton should continue on its present lines.	59
27	The selection known as the "Jalaun selection" might be given out at once, further selection work on it being carried out at the same time.	59

No.		PARA.
28	No further steps should be taken to promote the spread of the Aligarh white flowered variety until it has been definitely established that no other variety of <i>neglectum</i> can be found which will pay the cultivator as well.	60
29	A detailed survey of the indigenous cottons of the Provinces should be carried out at once, selection being made at the same time which should be tested on the Government farms.	61
In regard to agricultural work :—		
30	A detailed study of sowing methods should be carried out and efforts should be made to promote the adoption of the practice of sowing in lines and of interculture.	62
31	The possibility of growing a fodder crop with cotton in September or October should be considered.	62
32	The number and area of seed farms should be considerably increased.	63
33	The possibility of holding Government auctions of Cawnpore American <i>kapas</i> should be investigated.	63
34	The question of establishing cotton markets at important centres, such as Aligarh and Muttra, should be considered.	63
In regard to cotton under irrigation :—		
35	The concessions in regard to water supply at present being granted on certain channels in order to promote the extension of the cultivation of American cotton should be continued until their effect on the area under that variety can be definitely ascertained.	64
36	An area of 100,000 acres of American cotton on the Ganges Canals and of 35,000 acres on the Agra Canal may be anticipated, provided a sufficiently high premium for this variety can be assured.	65 and 67
37	A thorough investigation of the possibilities of tube wells and of pump irrigation by power should be taken in hand at an early date.	69
In regard to agricultural staff :—		
38	The Bundelkhand Districts should be formed into a separate circle to which a Deputy Director of Agriculture should be appointed and additional Deputy Directors should be appointed to the Central and Western Circles.	70
39	An additional Economic Botanist should be appointed whose main work should be on <i>deshi</i> cotton.	70
40	An Agricultural Entomologist, preferably with Egyptian or American experience, should be appointed.	70
<i>Chapter V.—Central Provinces and Berar.</i>		
In regard to botanical work :—		
41	Selection and hybridization work on the better types of <i>neglectum</i> such as <i>malvense</i> and <i>verum</i> and on <i>bani</i> (<i>indicum</i>) should be carried out with a view to the evolution of varieties with longer staple and higher ginning percentage.	78
42	Selection work on Cambodia should be carried out on the lines followed at Cawnpore and Lyallpur.	83
In regard to agricultural work :—		
43	Efforts should be made to spread the use of the Akola hoe.	79
44	Experiments should be made in regard to the possibilities of growing leguminous crops either with or instead of <i>juar</i> in the ordinary rotation of cotton and <i>juar</i> .	79

No.		PARA.
45	Duplicate tests should be carried out on an extensive scale especially in the Nagpur tract with a view to ascertaining with absolute definiteness the comparative yields of <i>roseum</i> and other varieties.	80
46	The trend of the market in regard to the price of <i>roseum</i> cotton should be carefully watched and the policy of the Agricultural Department should be regulated accordingly. If it is found impossible to evolve a superior variety of <i>neglectum</i> or <i>indicum</i> or a cross between them which can compete successfully with <i>roseum</i> in the matter of profit to the cultivator, vigorous measures should be taken to cover the whole of the cotton tract of the Provinces with that variety.	81
47	The Agricultural Department should continue to be in a position to supply pure seed of the <i>buri</i> variety for use in wilt infected areas.	81
48	The possibilities of Cambodia as an unirrigated crop on the black soil areas of Western Chhattisgarh should be investigated.	82
	In regard to cotton under irrigation.—	
49	An ultimate area of 7,000 acres under Cambodia cotton on the <i>bhata</i> lands of the Chhattisgarh Division may be expected in the near future.	82
50	As far as financial and other considerations permit, efforts should be made to provide water for as large an area of <i>bhata</i> land as possible.	82
51	The possibility of irrigation by pumping as a means of extending the cultivation of long staple cotton on the <i>bhata</i> lands should be investigated in due course.	82
	In regard to agricultural staff:—	
52	An Economic Botanist should be appointed to the Provinces who should devote his whole time to work on cotton.	83
	Chapter VI.—Sind.	
	In regard to cotton under irrigation:—	
53	The main reason for the failure of past efforts to grow Egyptian and American cotton in Sind has been the unsatisfactory character of the water supply.	90
54	There are no prospects of the successful cultivation of long staple cotton in Sind, unless the Sukkur Barrage Project is carried out.	91
55	If the Sukkur Barrage and the connected canals are constructed, an area of 400,000 acres of long staple cotton under the Rohri-Hyderabad, the Jamrao and the Eastern Nara Canals may be confidently anticipated.	98
56	In present conditions of supply, no area of long staple cotton can be looked for on any of the canals not affected by the Sukkur Barrage Project.	99
57	In constructing the canals taking off from the Sukkur Barrage, their possible enlargement to permit of an intensity of irrigation of at least 75 per cent. should be kept in view.	101
58	If the Sukkur Barrage Project is carried out, the water rates in Sind might eventually be brought up to the Punjab level, the rate for rice, in any case, being raised to correspond more nearly to the amount of water used.	102

No.		PARA.
59	The cultivation of rice should be entirely prohibited in tracts under the perennial canals in Sind in which it is not already grown, but, beyond the raising of the rate for rice, there should be no other restriction in areas in which it is at present cultivated.	102
60	A careful survey of the sub-soil water table should be carried out, either prior to or concurrently with the construction of the Sukkur Barrage.	103
61	The question of the prevention of malaria should be investigated, if the Barrage Project is undertaken.	104
	In regard to the colonization of the area affected by the Sukkur Barrage Project :—	
62	The question whether the land system of the Province is such as to render large areas of waste land on the new canals available for colonization should be thoroughly investigated by a strong Committee.	
63	If this proves to be the case, the desirability of making capitalist grants on the new canals should be considered, such grants to be from 2,000 to 5,000 acres in extent and to be made on conditions which would promote the speedy development of the tract and also render large supplies of pure seed available.	109
	In regard to the work of the Agricultural Department :—	
64	If it is eventually decided to abandon the Sukkur Barrage Project, all work on exotic cottons in Sind should be given up at the same time.	105
65	Meanwhile, no active propaganda in favour of American cotton should be carried on, but the Agricultural Department should continue to be in a position to supply seed to any cultivators who desire it and should assist in the marketing of their produce.	105
66	The main botanical work of the Agricultural Department should be on American and Egyptian cotton and should be directed to the evolution of better strains of the Triumph and <i>Milaffiffi</i> varieties.	106
67	Further efforts should also be made to evolve varieties of <i>deshi</i> cotton of long staple and higher ginning percentage than those at present grown.	106
68	Three pumping stations should be established on which the problems which will arise on the completion of the Sukkur Barrage and the connected canals should be worked out. Amongst such problems would be improvements in cultivation, suitable rotations, the cultivation of berseem and the like.	108
	In regard to agricultural staff :—	
69	The Agricultural Department in Sind should be separated from that of Bombay and should have its own Director of Agriculture with headquarters at Karachi.	110
70	The Province should be divided into two circles. An additional Deputy Director should be appointed for Upper Sind, with headquarters at Sukkur, whose main work would be the charge of the pumping stations, the establishment of which is suggested	110
71	An Economic Botanist should be appointed to the Province whose main work should be on cotton, especially the American and Egyptian varieties.	110

No.		PARA.
72	Until such time as Sind has an Agricultural College of its own, the subordinate staff of the Agricultural Department should be trained at the Lyallpur Agricultural College rather than at the Poona College.	110

Chapter VII.—Bombay.

	In regard to botanical work :—	
73	The relative value of the constituents of the Dholeras mixture should be definitely ascertained in order that the Agricultural Department and the cotton trade may be in a position to decide what steps should be taken in regard to them.	124
74	In the meantime, efforts should be made by persuasion and encouragement and by the provision of facilities for obtaining pure seed, to maintain the purity of <i>wagad</i> in the neighbourhood of Virangam and to restore <i>lalio</i> to its former purity in the Ahmedabad and Kaira Districts and in the adjoining parts of Baroda and Kathiawar.	124
75	In the Broach <i>deshi</i> tract, the Agricultural Department should endeavour to evolve a type of Broach cotton as superior to <i>goghari</i> in staple as is the present Broach cotton and also superior to it in yield and ginning percentage.	125
76	Work on the Surat farm should continue on its present lines but efforts should be made to evolve strains at least equal to, if not superior to, the best Navsari cotton which could be given out in the Surat tract. Only one improved strain of cotton should be given out at a time.	125
77	In the Khandesh tract, the aim of the Department should be to evolve by selection and hybridization, a strain of the yellow flowered varieties, such as <i>G. neglectum malcense</i> and <i>G. N. verum</i> superior to <i>G. N. roseum</i> in staple and at least equal to it in yield and ginning percentage.	126
78	In the Kumpta Dharwar tract, the work of the Department on the <i>kumpta</i> variety should continue on its present lines but only one improved strain of that variety should be given out at a time.	127
79	The efforts to eliminate the New Orleans type from the Dharwar American mixture should continue and more intensive work should be done on the Upland type by selection and hybridization.	128
80	No further botanical work should be done on the Dharwar Broach and Cambodia varieties.	128
	In regard to agricultural work :—	
81	The possibilities of steam and power ploughing should be further investigated and the possibility of handing over the work to a private agency, subsidized if necessary, at the outset by Government, should be considered.	129
82	Efforts should be made to extend the number and activities of co-operative seed unions and sale societies.	131
83	Steps should be taken to increase the number of seed farms in the Broach and Kumpta Dharwar tracts.	131
84	Efforts should be made to organize auction sales of the <i>kapas</i> of the improved strains of cotton in the Broach and Kumpta Dharwar tracts, the <i>kapas</i> being sold on the basis of purity rather than of ginning percentage.	131
85	The policy of handing over the control of auction sales to co-operative societies is of doubtful expediency but, if it is continued, such sales should be closely supervised by the Agricultural Department.	131

No.		PARA.
86	No further efforts should be made to push the Broach and Cambodia varieties in the Kumpta Dharwar tract.	131
87	The work on pushing <i>roseum</i> , in the Khandesh tract, should continue on its present lines until a final decision has been reached in regard to the possibility of replacing this variety by an improved strain of <i>neglectum</i> cotton. If this is found impossible, vigorous efforts should be made to cover the whole tract with <i>roseum</i> .	126
88	Efforts should be made to establish open markets on the Berar system in the cotton-growing tracts of the Presidency.	131
89	Loans under the Land Improvements Loans' Act for the construction of wells should be granted with some liberality in North Gujarat in view of the greatly increased yields of cotton which have been obtained under wells in that tract.	132
	In regard to agricultural staff :—	
90	The Northern Circle, with the addition of the Sholapur District from the Southern Circle, should be divided into three Circles, the Dholleras, Broach, and Khandesh tracts each forming a separate circle.	133
91	An Assistant Director of Agriculture should be appointed to the Southern Circle which should no longer include the Sholapur District.	133
92	Three additional botanists should be appointed to the Province, for the Dholleras and Broach, Khandesh, and Kumpta Dharwar tracts, respectively.	133
	In regard to cotton in Native States :—	
93	The possibility of appointing an experienced Agricultural Officer as Agricultural Adviser to the small States which cannot afford an officer of the standing of an Assistant Director of Agriculture should be considered.	134
94	All the Native States in the Province should decide, in consultation with the Bombay Agricultural Department, which type of cotton they wish to encourage in their territories.	134

Chapter VIII.—Madras.

	In regard to botanical work :—	
95	The work on "Westerns" cotton should continue on its present lines, efforts being made to evolve an improved type on black soils and to discover a type which can successfully compete with <i>roseum</i> or other <i>neglectum</i> varieties on red soils.	146
96	The work on "Northerns" should also continue on its present lines, efforts being made to bring the ginning percentage of the selection known as No. 14 up to 27 in order to enable it to be substituted for the local variety.	146
97	In the case of <i>karunganni</i> cotton, the object should be to isolate a type intermediate between Company No. 2 and Company No. 3.	146
98	A thorough survey of the Coconada tract should be taken up, as a preliminary to selection work on this variety on the same lines as are being followed in the "Westerns" and "Northerns" tracts.	147
99	Work on Cambodia should be taken up, the object being to evolve an improved type with a staple of at least an inch in length, and also, if possible, different types for irrigated and unirrigated land.	147

No.		PARA.
100	No botanical work on <i>upham</i> should be undertaken in view of the fact that this variety is being rapidly displaced by Cambodia and <i>karunganni</i> .	148
101	The experiments in crossing Bourbon and Cambodia should be recommenced and carried to definite conclusions, but beyond this, there should be no independent work on Bourbon or <i>nadam</i> cotton, as the elimination of these varieties is desirable owing to their propensity to harbour insect and other pests.	148
	In regard to agricultural work :—	
102	Efforts should be made to discover a suitable leguminous fodder crop for introduction into the rotation with cotton in the "Northern" and "Western" tracts.	149
103	The possibilities of gear and steam ploughing in these tracts should be investigated.	149
104	Efforts should be made to establish open markets in the "Northern" and "Western" tracts with a view to securing an improvement in the methods of picking. Such markets should also be established in the Coimbatore District.	149
105	The question of suitable manures and rotations for Cambodia cotton should be investigated.	149
106	The organization evolved for the distribution of pure seed in the Tinnevely tract should be extended to the other cotton-growing tracts, as soon as circumstances permit.	150
	In regard to the staff of the Agricultural Department :—	
107	Two additional Deputy Directors of Agriculture should be appointed, one for the "Northern" tract with headquarters at Nandyal and one for work on Cambodia.	152
108	A second Economic Botanist should be appointed, whose first work should be the survey of the Coconada cotton tract and who should also take up crossing work on Cambodia and Bourbon cotton. He should render the Deputy Directors of Agriculture advice and assistance in regard to the selection work carried out in the different circles.	152

Chapter IX. —Burma.

In regard to the botanical work :—

109	The first step should be a botanical survey of the cotton-growing tracts and a classification of the types grown as regards yield and ginning percentage.	159
110	Simple selection work should then be undertaken, the main object of which should be the standardization of the quality of the cotton.	159
111	Work on crossing, except in the case of the crosses already effected, should be postponed till a more adequate staff becomes available.	159
112	The possibilities of American cotton, particularly of Cambodia, should be thoroughly tested.	159
113	A large farm should be immediately established in the Meiktila or Myingyan district for work on <i>wa-gale</i> . Another should be established at Monywa in the Lower Chindwin District, which should be mainly utilized for experiments with cotton under well irrigation. To permit of work on <i>wa-gyi</i> , the Allanmyo farm should be equipped with a small ginning outfit.	159

No.		PARA.
	In regard to agricultural work :—	
114	As soon as adequate staff becomes available, special efforts should be made to promote the introduction of improved implements and improved methods of cultivation, the evolution of an organization for the distribution of pure seed and the improvement of the present system of marketing.	160
	In regard to agricultural staff :—	
115	A large increase in the superior and inferior staff of the Agricultural Department is urgently required for the general agricultural development of the Province. The strengthened staff should devote special attention to work on cotton.	161
116	An Economic Botanist should be appointed to the Province at an early date, one of whose duties should be to undertake a botanical survey of the cotton growing tracts.	161
	<i>Chapter X.—Bengal, Bihar and Orissa and Assam.</i>	
117	The experiments with <i>buri</i> and selected American varieties in Chota Nagpur should continue on their present lines.	166
118	The botanical survey of the cotton tracts in the three provinces should be completed.	166
119	Selection work on the Comilla variety should be undertaken with a view to the improvement and standardization of its ginning percentage and, possibly also, of its staple.	166
	<i>Chapter XI.—Hyderabad.</i>	
120	A botanical survey of the cotton tracts should be carried out in order that the Agricultural Department should be in a position to decide on a definite policy for each tract.	172
121	Simultaneously with, or subsequent to such a survey, exhaustive tests should be carried out in order that the comparative merits of <i>bani</i> and other varieties may be authoritatively ascertained.	172
122	Further tests should be carried out with Cambodia before the seed of this variety is given out on a large scale.	172
123	Botanical work on <i>tani</i> on the lines proposed for British Provinces should be commenced as soon as possible and should be followed by similar work on other varieties.	172
124	Botanical work should be carried out in close co-operation with specialists working in British Provinces, and if His Exalted Highness the Nizam's Government wish it, such officers should freely render advice and assistance.	172
125	The superior staff of the Agricultural Department should be increased by the appointment of two Deputy Directors, one for the Mahratwarra and the other for the Telingana Country and of an Economic Botanist and the main work of these officers should be on cotton.	173
	<i>Chapter XII.—Baroda.</i>	
126	No further efforts should be made to introduce exotics in the Baroda State, but the efforts of the Agricultural Department should be confined to the improvement of the indigenous varieties and the production of good seed for distribution.	178
127	In order to build up an organization for the production and distribution of good seed, the subordinate staff of the Agricultural Department should be increased by the appointment of additional officers of the class of Agricultural Assistant.	178

No.		Para.
128	The Agricultural Department should devote itself more particularly to work on the <i>Dholleras</i> mixture and should make special efforts to maintain the purity of <i>wagad</i> and to restore <i>lalio</i> to its former standard in the Kadi District.	178
129	All work on cotton in Baroda should be carried out in close co-operation with the Bombay Agricultural Department, periodical conferences being held between the officers of the two Departments.	178
130	The organization for the spread either of pure varieties or of improved types should follow the lines proposed for the adjacent tracts in the Bombay Presidency.	178

Chapter XIII.—Central India.

131	The main line of work on cotton in Central India should be selection work on <i>malvense</i> and the evolution of a suitable organization to secure that this variety is marketed in a pure state.	185
132	The experiments with Upland Georgian and Cambodia under irrigation and with Mr. Leak's improved varieties should be continued.	185
133	If work on <i>malvense</i> proves impossible owing to difficulty in obtaining pure seed, the Agricultural Department should concentrate its energies on pushing Upland Georgian or Cambodia on irrigated soils, provided further tests establish the suitability of these varieties.	185
134	The desirability of making the post of Joint Agricultural Adviser a permanent one and of establishing a large farm on which he can carry out work for the benefit of all states should be considered.	185
135	Separate Directors of Agriculture should be appointed for the Indore and Bhopal States.	185
136	Throughout the Agency, there should be an expansion of the experimental work on cotton and an increase in the subordinate staff of the Agricultural Department.	185
137	The possibilities of well irrigation should be thoroughly investigated.	186

Chapter XIV.—Rajputana and Mysore.

138	Work on cotton in Rajputana must await the development of Agricultural Departments in the different States. A botanical survey of the cotton-growing tracts is an essential preliminary to such work.	189
139	Work on cotton in Mysore should be carried out in close co-operation with the Bombay Agricultural Department as the problems are similar to those arising in the adjacent tracts of the Bombay Presidency.	190
140	Further experiments with Cambodia on irrigated soils should be carried out in Mysore.	190

Chapter XV.—General recommendation in regard to Agricultural work on cotton.

141	Botanical surveys of the cotton-growing tracts are of very great importance. Simultaneously with or subsequent to such surveys, the varieties found on a field scale should be tested on duplicate or triplicate plots in order that it may be ascertained whether any of the types is distinctly superior to the others.	193
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No.		PARA.
142	Selection work should be regarded as the first step in obtaining an improvement in cotton, but should be followed by crossing which should, however, only be entrusted to properly qualified officers who can devote personal attention and considerable time to it.	194
143	Tests of cotton on a field scale should be carried out in two series, the first series consisting of preliminary tests on small plots, and the second series of tests on larger plots under conditions approximating, as far as possible, to those under which cotton is ordinarily grown.	195
144	As regards the question of obtaining an improvement in the outturn of cotton, one of the most important requirements is the introduction into the rotation of a heavy yielding leguminous fodder crops.	196
145	The selection and distribution of pure seed should be entirely controlled by the Agricultural Department. The desirability of taking immediate steps to select and acquire land for seed farms should be considered.	197
146	Demonstration should ordinarily be carried out on the lands of selected cultivators. Where the establishment of large demonstration farms is considered desirable, an accurate profit and loss account should be maintained.	198
147	No further work on tree cottons should be done by the Agricultural Department, except where it is desired to obtain crosses between such cottons and annual varieties.	199
148	An additional mycologist should be appointed to the Pusa staff whose principal duty should be the investigation of mycological problems connected with cotton.	200
149	The total cost of the proposals for the expansion of the Agricultural Department and for the Central Cotton Committee amounts roughly to Rs. 16 lakhs. If considered desirable, funds might be provided by the imposition of a cess of eight annas a bale on all cotton used in the mills in India or exported.	202
150	The additional staff proposed should be recruited immediately from any available source. In some cases, candidates from the United Kingdom or the United States might be recruited on short-term agreements, in order that their place may be taken by Indians possessing the requisite agricultural qualifications as soon as they become available.	203

PART II.

Chapter XVI.—Commercial.

151	Cotton markets on the Berar system should be established in other provinces as soon as possible, more especially in the cotton tracts of the Bombay Presidency, except Sind, the Madras Presidency, except the Coconada tract, and the Punjab Canal Colonies.	205
152	Cotton prices should be published in up-country markets, subject to certain limitations.	206
153	The dates of the payment of instalments of land revenue in the cotton-growing tracts of the Bombay Presidency, except Sind and Khandesh, should be altered.	207

No.		PARA.
154	Efforts should be made to expand the numbers and activities of co-operative sale societies, such societies, at the outset, to be initiated and supervised by the Agricultural Department.	208
155	Auction sales, conducted by Government agency, are advisable in the case of new varieties up to a certain stage, after which the work should be handed over to other agencies, subject to suitable arrangements being made in regard to the control of seed.	209
156	The formation of buying agencies should be left to the trade .	210
157	There should be no interference with the practice of forward sales by the cultivator or middleman or with the purchase of cotton "forward" by mills or exporters in the ordinary course of trade.	211
158	The weights used in all cotton markets and ginning and pressing factories throughout India should be standardized on the basis of a cotton maund of 28 pounds.	215
159	The Agricultural Department should undertake experiments with the cleaner picking of cotton, in order to enable definite conclusions to be arrived at in regard to the value of cotton so picked.	216
160	The transport of cotton waste or fly by rail or sea, except from one spinning or weaving mill to another or to a port for shipment outside India should be totally prohibited.	220
161	The transport of loose <i>kapas</i> or lint in <i>docras</i> or of half pressed or full pressed bales by rail, except to <i>bona fide</i> consumers and to ports for disposal there or shipment outside India, should also be prohibited except, in certain cases, under license.	221
162	All ginning and pressing factories should be licensed, a preliminary to the issue of licenses being the assignment to all factories of distinctive numbers and marks which would enable the cotton dealt with in them to be traced.	223
163	Licenses should only be granted on certain conditions and should be withdrawn for breach of these conditions and on proof of such malpractices as damping, mixing and adulteration.	225 and 228
164	All ginning and pressing factories should be brought under the operation of the Factory Act and required to take out licenses, irrespective of the number of hands employed.	227
165	Licenses should be withdrawn by the Local Government on the recommendation of the Central Committee, after the procedure laid down has been followed.	228 and 229
166	Suitable penalties should be imposed in the case of factories working without taking out a license or after a license has been withdrawn.	229
167	Where ginning and pressing pools exist, and in consequence there are more factories than are really required, concessions in regard to the grant of land should be offered to induce the surplus factories to move to other localities. In such circumstances, no night shift working should be permitted.	231
168	The question of the possibility of using saw gins for Indian cotton as well as of improving roller gins should be further investigated.	232

Chapter XVII.—Statistical.

In regard to the improvement of the cotton forecasts :—

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| 169 | The work of submitting estimates of outturn should everywhere be handed over to the Agricultural Department as soon as possible, a beginning being made in the meantime, in tracts in which the Department is sufficiently organized for the purpose. | 238 |
| 170 | The results obtained on Government farms should be utilized more largely than at present, especially for purposes of comparison with previous years and for ascertaining ginning percentages. | 239 |
| 171 | Measures should be taken to impress upon primary reporting agencies the meaning of the term "normal" and its equivalent in annas. A twelve-anna crop should everywhere be regarded as representing a normal crop, unless there are special reasons to the contrary. | 240 |
| 172 | The desirability of substituting a quantitative estimate for the anna estimate should be considered. | 240 |
| 173 | The yield of cotton should invariably be reported by primary reporting agencies in terms of <i>kapas</i> , the necessary conversion into terms of ginned cotton and of the anna estimate into American notation being made in the office of the Provincial Director. | 240 |
| 174 | Special care should be taken in estimating the outturn of cotton when grown with other crops. | 240 |
| 175 | More use should be made in regard to figures of outturn of non-official agencies, such as large firms, large and small land holders, and ginning factories. | 241 |
| 176 | The figures of outturn should be checked with statistics of export, mill consumption and extra-factory consumption. Care should be taken to see that the comparison with the outturn of the previous year is made on the basis of the finally corrected estimates for the latter. | 242 |
| 177 | There should be a careful check of the returns in the office of the Director of Agriculture, an officer of the standing of an Assistant Director of Agriculture being attached to it for work connected with forecasts in provinces in which the Director has not sufficient time to devote to them. | 243 |
| 178 | A fifth and final forecast of the cotton crop should be issued in April to enable information in regard to the Madras crop to be included in it. | 244 |

In regard to the press returns :—

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| 179 | The submission of returns of cotton ginned and pressed by ginning and pressing factories should be made compulsory by legislation, the penalty to be the withdrawal of the license of the factory. | 245 |
| 180 | The returns, both from British Territory and Native States, should be sent direct to the Department of Statistics. | 246 |
| 181 | The form of the return should be improved in certain respects . | 247 |

In regard to the office of the Director of Statistics :—

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| 182 | The section of the office which deals with agricultural statistics should be considerably strengthened. | 248 |
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No.		PARA
	<i>Chapter XVIII.—Establishment of a Central Cotton Trade Association in Bombay.</i>	
183	One Central Association, to be known as the East India Cotton Association, should take the place of the seven distinct bodies which at present control the cotton trade in Bombay. This Association should establish a proper basis of classes of cotton for "future" contracts, should license brokers and commissioned houses and should establish a clearing house for settlements at least weekly. The question of including in the scheme for such an Association, which we have requested Mr. Wadia to draw up, provisions for a "mutual allowance" system on the lines of that of the Bremen Exchange and of the appointment of official arbitrators should be carefully considered.	252
184	All speculative transactions in <i>kutchha khandis</i> , " <i>kutchha</i> Americans" or "single and double options" should be entirely prohibited.	251
185	The East India Cotton Association, when formed, should take up the question of devising some better methods of classification than that at present adopted.	257
	<i>Chapter IX.—Formation of a Central Cotton Committee.</i>	
186	In order to secure co-ordination and co-operation in all matters relating to cotton, a Central Cotton Committee of a permanent character, composed of representatives of the Agricultural and Co-operative Departments, the Director General of Commercial Intelligence, the Director of Statistics and representatives of the trade should be established at Bombay. The Agricultural Adviser to the Government of India should be the President of the Committee, the staff of which should include a whole-time Secretary and a Technologist. The main functions of the Committee would be to act as an advisory body to Government and the trade on all matters connected with cotton, including questions relating to legislation and the licensing of ginning and pressing factories, to act as a centre for the dissemination of information regarding cotton and to assist the Agricultural Department, through its Technologist, in obtaining authoritative valuations of new varieties.	260 and 262
187	In order to carry out its functions, the Committee would act through and with Provincial Committees and local sub-committees. Such Committees would be formed in all the provinces in which cotton is grown, except Bihar and Orissa and Assam. In view of the special circumstances of Burma, the Provincial Committee in that province would be the advisory body in regard to the licensing of ginning and pressing factories.	263
188	The post of Imperial Cotton Specialist will cease to be necessary on the formation of the Central Cotton Committee and should be abolished on the retirement of its present holder.	266
189	Samples of cotton submitted by the Agricultural Department for trade valuation should, in the first instance, be not less than 20 pounds of lint. If the report on these is satisfactory, 200 pounds of the cotton grown on a field scale and handled under ordinary conditions should be sent for a mill test.	267

